DEMONSTRATIONS

OF

ANATOMY;

BEING

A Guide to the Knowledge

OF THE

HUMAN BODY BY DISSECTION.

BY

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PREFACE.

THIS work was specially designed to teach anatomy by dissection of the human body in regions or parts, and thereby to promote instruction after a practical method.

Since the first appearance of the publication its usefulness has been tested by repeated trial; and the demand for another edition may be received as evidence of the fitness of the book for the attainment of the end in view.

In this edition of my "Demonstrations of Anatomy" no alteration has been made in the plan of the work, which still consists of a system of dissections after the following method. In the examination of a region the attention of the student is directed first to its limits, to the superficial prominences of bone or muscle, and to the impressions that point out the situation of the subjacent vessels. The different strata interposed between the surface and the bones are next examined in succession, with reference particularly to the natural position of the several objects, and their connections one with another, so that they may be observed in much the same order as they would be met with in an operation of surgery. The anatomical description of the whole is likewise arranged in conformity with the mode of dissection, and each blood-vessel, nerve, or other structure,

is described only to such an extent as it may be laid bare in the region under examination.

The full instructions for conducting the progressive stages of a dissection, which were peculiar to the former edition, have been revised, and are now better adapted for enabling the student to follow without other aid the more difficult directions, and to recognize objects that become visible on the removal of the superficial parts.

A few changes in the order of arrangement, which farther experience suggested, have also been made in the book; whilst occasional repetitions, and some detail have been omitted, to render it more serviceable to the beginner. At the same time I have not failed to introduce those additions which had become necessary from the increase in our stock of anatomical knowledge.

G. V. E.

Sept. 28. 1849.

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CORRIGENDA.

Page 1. line 19. for "retrahens" read "attollens."
35. line 2. for "anterior" read "posterior."
58. line 6. insert "muscle" after "digastric."
91. line 11. } for "superior" read "middle."
92. line 12. }
136. line 17. for "inwards" read "outwards."
249. line 12. for "coraco-brachialis" read "brachialis anticus."
249. line 22. for "outer" read "inner."
275. line 12. for "carpal" read "metacarpal."
275. line 38. for "second" read "third."
327. line 9. for "subclavian" read "carotid."
352. line 22. for "between" read "with two."
410. line 31. for "and" read "or."
419. line 16. for "triangular" read "suspensory."
438. line 20. for "ilium" read "os pubis."

NOTICE.

It was my intention to complete the second edition of my "Demonstrations of Anatomy" by the time specified in the advertisements, but a temporary want of health has obliged me to defer its publication. After this interruption to my plan of producing the whole of the work early enough for the student to use it during the present winter, I thought the publication of the sheets that are already printed might be serviceable to those students who wish to use the "Demonstrations," but are unable to obtain a copy of the former edition in consequence of its having been some time out of print. With the consent, therefore, of the publishers, the finished sheets now appear as part of the work.

The remaining portion of the volume will be ready by next October.

G. V. E.

Univ. Coll. London,
Dec. 9. 1848.

DEMONSTRATIONS OF ANATOMY.

CHAPTER I.

DISSECTION OF THE HEAD AND NECK.

Section I.

EXTERNAL PARTS OF THE HEAD.

Directions respecting the dissection.

The superficial parts of the head may be examined first with most advantage so as to allow the speedy removal of the brain. When beginning his task the student should observe that he has to proceed as far as the end of the description of the posterior triangular space of the neck before the position of the body is changed for the dissection of the back.

Position of the body.

Dissection.—During the examination of the scalp, the body lies on the back with the head raised to a suitable height. On the left side, the muscles are to be exposed, and on the opposite side the vessels and nerves are to be afterwards displayed.

Dissection of muscles of the ear;

To expose two small muscles above the ear, draw down the pinna with hooks, and carry the scalpel upwards on the side of the head for about three inches above the ear, along the centre of a subcutaneous prominence. A second incision, of about the same length, is to be made transversely close to the ear. On carefully raising the flaps of skin and the subjacent tissue, very thin muscular fibres come into view, the more anterior fibres constituting the attrahens, and the posterior the retrahens aurem muscle. For the dissection of a posterior muscle, draw forwards the ear, and behind it make an incision from the transverse one already existing, as far as to a level with the lower extremity of the pinna, where it is to be carried forwards below the ear. Reflect the piece of skin forwards,

and the retrahens muscle will be easily found beneath the subcutaneous tissue, for it is stronger though deeper than the others.

and of occipito-frontalis. On the same side of the head (the left) the occipito-frontalis is to be dissected. To bring this muscle into view, make a cut along the middle line of the skull, from the root of the nose to a little below the occipital protuberance, and connect it in front with the transverse incision on the side of the head. In raising and throwing backwards the flap of skin, the dissector will expose first the anterior fleshy part of the muscle, next a white shining thin aponeurosis, and lastly a posterior fleshy belly towards the outer part of the cranium. The student should bear in mind that the aponeurosis of the muscle is easily taken away with the granular fat.

Muscles of the ear. MUSCLES OF THE EXTERNAL EAR.—Three muscles fix the pinna to the side of the head. Two are above the ear, one elevating it, the other drawing it forwards; and one, a retrahent muscle, is behind the ear. There are other special muscles of the cartilage of the ear, which will be afterwards described.

Attrahens aurem muscle The ATTRAHENS AUREM is a small fan-shaped muscle that *arises* from the aponeurosis of the occipito-frontalis, near its anterior part. Its fibres are directed backwards, and are *inserted* into the front of the rim of the ear (the helix). is united with next. This muscle is united with the following at its origin, but a cellular interval exists between them near the ear. Beneath it are the temporal vessels.

Attollens aurem muscle. The ATTOLLENS AUREM has the same form as the preceding, though its fibres are more marked. Arising also from the tendon of the occipito-frontalis, the fibres converge to their *insertion* into the posterior aspect of the pinna of the ear (viz. the concha).

Retrahens aurem consists of two or three bundles. The RETRAHENS AUREM (*musculi retrahentes*, Alb.) consists of two or three roundish bundles of fibres, which are stronger than those of the other muscles. The fibres *arise* from the mastoid process, and pass almost transversely inwards to be *inserted* by aponeurotic fibres into the lower part of the concha at its cranial aspect. The posterior auricular artery and nerve are in connection with this muscle.

Occipito-frontalis; The OCCIPITO-FRONTALIS MUSCLE covers the arch of the skull, and consists of an anterior and a posterior fleshy part, with an intervening tendon.

The *anterior* or *frontal* part is a thin muscular expansion over the os frontis, which has little attachment to the subjacent bone, but mixes with the muscles of the face. Along the line of the eyebrow (its *origin*) the fibres are blended with those of the orbicularis palpebrarum and pyramidalis nasi, and a few are also fixed to the internal angular process of the os frontis. From this attachment the fibres are directed upwards to the aponeurosis, which they join rather below the level of the coronal suture. Frontal part,

The *posterior* or *occipital* part is stronger than the anterior; it *arises* from the mastoid process of the temporal bone, and the outer two-thirds of the upper curved line of the occipital bone. The fibres ascend to end in the aponeurosis. occipital part,

The *tendon*, or epicranial aponeurosis, extends over the upper part of the cranium, and is continuous across the middle line with the same structure of the opposite half of the head. On the side it gives origin to the auricular muscles, and a thin fascia is prolonged from it over the temporal aponeurosis. and aponeurosis.

Superficial to the occipito-frontalis are the different vessels and nerves of the scalp. The aponeurosis is moreover closely connected to the skin, whilst it is separated from the pericranium by a loose cellular membrane, which admits of the free movement of the tendinous structure. Posteriorly the fleshy parts of the muscles of opposite sides do not meet, and the aponeurosis is attached to the ridge of the occipital bone between them. Its connections.

Dissection.—The attachment of the temporal fascia will be seen on the side of the head after the removal of the superior auricular muscles, the epicranial aponeurosis and its prolongation, together with the temporal vessels. Dissection.

The *temporal fascia* is a white, shining membrane, which is much stronger than the epicranial aponeurosis, and gives attachment to the subjacent temporal muscle. Superiorly it is inserted into the curved line that limits the temporal fossa on the side of the skull; and inferiorly, where it is narrower and thicker, it is fixed to the zygoma. By its cutaneous surface the fascia is in contact with the muscles already ex- Temporal fascia. Attachments. connections,

amined, and with the superficial temporal vessels and nerves.

and layers. An incision into the fascia, a little above the zygoma, shows it to consist there of two layers, which are fixed to the margins of that process of bone. Between the layers is some cellular membrane, with a small branch of the temporal artery, and a slender twig from the orbital branch of the superior maxillary nerve.

Dissection. *Dissection.*—Detach the fascia from the skull and temporal muscle, and throw it down. Then remove a soft cellular tissue that lies between the two, near the zygoma. The difference in the thickness of parts of the fascia will be conspicuous.

Temporal muscle. The TEMPORAL MUSCLE is now partly exposed. It is wide and thin above, but becomes narrower and thicker at the

Origin. lower part. The muscle *arises* from the temporal fascia, and from all the surface of the impression on the side of the skull known as the temporal fossa. From this origin the fibres descend and converge around a tendon which is *in-*

Insertion and *serted* into the coronoid process of the lower jaw. On the cutaneous surface is the temporal fascia, with the parts

connections. superficial to that membrane; and the muscle conceals the deep temporal vessels and nerves, which ramify in it. The insertion of the muscle beneath the zygoma will be afterwards followed.

Dissection.—Next remove the piece of skin that covers the opposite half of the head, to expose the vessels and nerves. An incision may be made along the eyebrow and zygoma to a little behind the ear, which will allow the flap of integument to be raised and thrown backwards. Behind the ear the skin should be reflected as on the other side, in order to expose the posterior auricular vessels and nerves. All the subcutaneous fat should be left till the nerves are found. Along the eyebrow are the branches of vessels and nerves that come from the orbit, but lie at first beneath the occipito-frontalis, viz. the supra-orbital and frontal vessels, and the supra-orbital and supra-trochlear nerves. On the side of the head, in front of the ear, are the superficial temporal vessels and nerves, with branches of the facial nerve; and behind the ear the posterior auricular vessels and nerve. At the back of the head are the ramifications of the occipital vessels, and the large and small occipital nerves.

Arteries CUTANEOUS VESSELS.—The arteries of the scalp are fur-

nished by the internal and external carotid arteries, and anastomose freely on both sides of the head. Only two small branches, the supra-orbital and frontal, come from the former; whilst the temporal, occipital, and posterior auricular arteries are offsets of the latter. of the scalp.

The *supra-orbital branch* of artery leaves the orbit with the nerve of the same name, and is distributed on the forehead. Some of its branches are superficial to the occipito-frontalis, and ascend towards the top of the head, whilst others remain beneath the muscle, and supply it and the periosteum. Supra-orbital artery.

The *frontal branch* is close to the inner angle of the orbit, and is much smaller than the preceding. It soon ends in branches of distribution to the muscles, integuments, and periosteum. Frontal artery.

The *superficial temporal artery* is the terminal branch of the external carotid. Ascending over the zygoma, the vessel divides on the temporal fascia into anterior and posterior branches. Superficial temporal divides into

a. The *anterior division* runs forwards with a serpentine course to the forehead, and supplies muscular, cutaneous, and pericranial offsets: it also anastomoses with the supra-orbital artery. It is this branch of bifurcation that is opened when blood is taken from the temporal artery. anterior and

b. The *posterior division* is larger than the other, and arches backwards above the ear towards the occipital artery, with which it anastomoses. Its branches of distribution are similar to those of the other division, and it communicates moreover with the artery of the opposite side over the top of the head. posterior part.

Occipital Artery.—The terminal part of this artery, after perforating the trapezius, divides into large and tortuous branches, which spread over the back of the head and occipito-frontalis muscle. Communications are established between these branches and the artery of the opposite side, the posterior division of the temporal, and the following artery. Some offsets pass deeply to supply the muscle, pericranium, and bone. Occipital artery.

The *posterior auricular artery* appears in front of the mastoid process, where it divides into two branches. One (mastoid) is directed backwards to supply the occipito-frontalis, and anastomose with the occipital artery. The other (auricular) is furnished to the retrahent muscle and back of the pinna of the ear; and an offset pierces the pinna to be distributed on the opposite surface. Posterior auricular.

The VEINS of the exterior of the head are so similar to the arteries, that a full notice of each is not required. All veins Veins of the scalp

corresponding to the branches of the internal carotid artery enter the facial vein, whilst the rest open into the jugular veins.

same as the arteries. The *frontal vein* is directed towards the inner angle of the orbit, where it receives the *supra-orbital* vein, the two giving rise to the angular vein of the face. Both the *superficial temporal* and *posterior auricular* veins open into the external jugular; and the *occipital* joins the internal jugular vein.

Nerves of the scalp are CUTANEOUS NERVES. — The terminal parts of the several nerves that now come into view are furnished from both the cranial and spinal nerves. The half of the head anterior to the ear receives branches from the three divisions of the fifth cranial nerve, and a few filaments from the facial nerve. All the rest of the head is supplied by spinal nerves, from both anterior and posterior divisions, except close behind the ear, where there is a branch of the seventh cranial or facial nerve.

Supra-orbital nerve; The *supra-orbital nerve* is a branch of the first division of the fifth nerve, and escapes from the notch in the upper margin of the orbit; whilst beneath the occipito-frontalis muscle, the nerve gives offsets to it and the orbicularis palpebrarum, also others to the pericranium. Finally, the nerve ends in two cutaneous branches, which ramify between the epicranial aponeurosis and the skin.

its two cutaneous branches, One of these (inner) soon pierces the occipito-frontalis, and reaches backwards as far as the parietal bone. The other branch (outer) is of larger size, and perforating the muscle farther back, extends over the arch of the head to the occipital bone. Whilst the nerve is escaping from the supra-orbital notch it furnishes some filaments (palpebral) to the upper eyelid. In the orbicular muscle a communication is established between the supra-orbital and facial nerves.

and supra-trochlear branch. At the inner angle of the orbit is the small *supra-trochlear branch* of the same nerve. It turns upwards to the forehead beneath the orbicular muscle of the eyelids, and piercing the muscular fibres ends in the integument. Branches are given from it to the orbicularis and corrugator supercilii, and some twigs (palpebral) descend to the eyelid.

Temporal nerves; The *superficial temporal nerves* are derived from the second and third divisions of the fifth, and from the facial nerve.

a. The *branch* of the *superior maxillary nerve* (second division of the fifth) is usually a slender twig, which perforates the temporal aponeurosis, about a finger's breadth above the zygoma. When become cutaneous, the nerve is distributed on the temple, and communicates with the facial nerve, also sometimes with the next. from superior maxillary;

b. The *temporal branch* of the *inferior maxillary nerve* (third division of the fifth) is near the ear, and accompanies the temporal artery to the top of the head. As soon as the nerve emerges from beneath the parotid gland, it furnishes an auricular branch (upper) to the anterior part of the pinna, above the auditory meatus, and then divides into two terminal branches. The more posterior branch is the smaller of the two, and supplies the attrahens aurem muscle and the integument above the ear. The other branch ascends vertically to the top of the head, and is distributed above the epicranial and temporal aponeuroses. from inferior maxillary.

c. The *temporal branches* of the *facial nerve* are directed upwards over the temporal aponeurosis to the orbicularis palpebrarum muscle. They will be noticed in the dissection of the trunk of the facial nerve. and from facial nerve.

The *posterior auricular nerve* is close behind the ear with the artery of the same name. It arises from the facial nerve close to the stylo-mastoid foramen, and turns upwards in front of the mastoid process. Soon after the nerve becomes superficial, it communicates with the great auricular nerve, and divides into an occipital and an auricular branch, which are distributed as their names express. Posterior auricular nerve has

a. The *occipital branch* is long and slender, and ends in the posterior belly of the occipito-frontalis. It lies near the occipital bone, enveloped in dense fibrous structure, and furnishes offsets to the integuments. occipital branch,

b. The *auricular branch* ascends to the back of the ear, supplying the retrahent muscle and posterior aspect of the pinna. and auricular.

The *great auricular nerve* (of the cervical plexus) is seen to some extent at the lower part of the ear, but its anatomy will be afterwards given with the description of the cervical plexus. Great auricular nerve.

The *great occipital* is the largest cutaneous nerve at the back of the head, and is recognised by its proximity to the occipital artery. Springing from the posterior division of the second cervical nerve, it perforates the muscles of the back of the neck, and divides on the occiput into numerous large branches, that spread over the posterior part of the occipito-frontalis muscle. The branches of the nerve end mostly in the integument, and one (*auricular branch*) reaches the cranial aspect of the ear. As soon as this nerve pierces Great occipital nerve gives an auricular branch.

the trapezius, it is joined by an offset from the third cervical nerve; and on the back of the head it communicates also with the smaller occipital nerve.

Small occipital nerve

The *small occipital nerve* of the cervical plexus is midway between the ear and the preceding nerve. With this position, the nerve is continued upwards in the integuments higher than the level of the ear. It communicates with the nerve on each side: viz. the posterior auricular and great occipital. Usually this nerve furnishes an *auricular branch* to the upper part of the ear at its cranial aspect, which supplies also the attollens aurem muscle.

has an auricular branch.

Section II.

INTERNAL PARTS OF THE HEAD.

Dissection to open the skull.

Dissection. — Before opening the skull, detach the temporal muscle of the right side from the bone nearly down to the zygoma, without separating the fascia and muscle one from another. Then divide the soft parts around the skull, the knife being carried about one inch above the margin of the orbit in front, and as low as the occipital protuberance at the posterior part of the head. Next saw the outer plate of the bones of the cranium in the same line as the incision, and break through the inner plate with a chisel, in order to avoid injuring the subjacent membrane of the brain (dura mater). Forcibly detach the skull cap, and the dura mater is exposed.

Dura mater.

The DURA MATER is the most external of the membranes investing the brain. It is a strong, fibrous structure, that serves as an internal periosteum to the bones, and supports the cerebral mass. The outer surface of the membrane is rough, and presents, now it is separated from the bone, numerous small fibrous and vascular processes. Along the line of the sutures, and at the base of the skull, the attachment of the dura mater to the bone is much the most intimate. Ramifying on the membrane are branches of the middle meningeal vessels, ascending towards the top of the head. Small granular bodies, glands of Pacchioni, are also seen along the middle line. The number of these bodies is very variable, and is increased with age. Occasionally the surface of the skull is indented by these so-called glands.

Appearance of outer surface.

Dissection. — Cut through the dura mater with a scissors close to the sawn skull, except in the middle line before and behind, where the superior longitudinal sinus lies. Raise the cut membrane towards the top of the brain, and on the right side break through the veins connecting it with the cerebral hemisphere. Dissection.

When the dura mater is cut through, its inner surface is seen to present a smooth and polished aspect, in consequence of the reflection over it of the arachnoid or serous membrane. Inner surface.

This external envelope of the brain consists of white fibrous tissue, so disposed as to give rise to two distinct layers. At certain spots these layers are slightly separated, and form thereby the spaces or sinuses for the passage of the venous blood. Moreover, the innermost layer sends processes between different parts of the brain, viz. falx, tentorium, &c. Structure and processes.

The *falx cerebri* is a process of the dura mater, in shape like a sickle, that dips between the hemispheres of the cerebrum, along the middle line. Its form and extent will be evident if the right hemisphere is gently separated from it. It is narrow and pointed in front, where it is attached to the crista galli of the ethmoid bone, but widens posteriorly, and joins a horizontal piece of the dura mater, viz. the tentorium cerebelli. The upper border is convex, and is fixed to the middle line of the skull as far backwards as the occipital protuberance; whilst the lower, or free border, is concave, and turned towards the corpus callosum, with which it is in contact posteriorly. In this fold of the dura mater are contained the following sinuses:—the superior longitudinal along the convex border, the inferior longitudinal in the lower edge, and the straight sinus at the line of junction between it and the tentorium. Falx. Form and attachments. Sinuses in it.

The *superior longitudinal sinus* extends from the ethmoid bone to the occipital protuberance. Its position in the convex border of the falx will be made manifest by the escape of blood through numerous small veins, when the finger is carried backwards along the middle line. When the sinus is opened, it is seen to be narrow in front, and to become wider as it proceeds backwards, till it ends in a common point of union of certain sinuses (torcular Herophili). Its Superior longitudinal sinus. Situation and ending.

Its interior. cavity is triangular in form, with the apex of the space turned to the falx; and across it are stretched small tendinous cords (chordæ Willisii) around the openings of the cerebral veins. Occasionally small glandulæ Pacchioni are present in the sinus.

Veins opening into it. This sinus receives small veins from the substance and the exterior of the skull, and larger ones from the hemispheres of the brain. The cerebral veins open chiefly at the posterior part of the brain, and lie for some distance against the wall of the sinus before they perforate it; their course is likewise directed from behind forwards, so that the motion

Current of blood in it. of the blood in them is directly opposed to the current in the sinus. This disposition of the veins may be seen on the left side, where the parts are undisturbed.

Dissection for removal of brain. *Dissection.* — Before the rest of the dura mater can be seen, the brain is to be taken from the body. To facilitate this step, raise the shoulders by a block (if this has not been done) and incline the head backwards, in order that the brain may separate somewhat from the base of the skull. Cut across now the anterior part of the falx cerebri, also the different cerebral veins entering the longitudinal sinus, and raise and throw backwards the falx. For the division of the nerves and vessels of the brain, a very sharp scalpel will be necessary; and the nerves are to be cut longer on one side than the other.

Mode of proceeding and parts cut. *Removal of the brain.* — Begin the removal of the brain by gently raising with the fingers the anterior lobes and the olfactory bulbs. Next cut through the internal carotid artery and second and third nerves, which first present themselves to the dissector; the artery having the large second nerve on its inner, and the round third nerve on its outer side. A small branch of artery to the orbit should likewise be divided at this time. The brain is now to be supported in the left hand, and the pituitary body to be dislodged from the hollow in the centre of the sphenoid bone. Afterwards a strong horizontal process of the dura mater (tentorium cerebelli) comes into view, and along its free margin will be seen the small fourth nerve, which is to be cut at this stage of the proceeding. Next make an incision through the tentorium on each side, close to its attachment to the temporal bone, without injuring the parts underneath. The following nerves will now appear, and be divided in succession. Near the inner margin of the tentorium is the fifth nerve, consisting of a large and small

root; whilst towards the middle line is the long slender sixth nerve. Below the fifth, and somewhat external to it, is the seventh nerve with its facial and auditory parts, the former being anterior and the smaller of the two. Directly below the seventh are the three divisions of the eighth nerve in one line: of these, the upper small piece is the glosso-pharyngeal; the flat band next below, the pneumo-gastric; and the long round nerve ascending from the spinal canal, the spinal accessory division. The remaining nerve is the ninth, which consists of two small pieces. After dividing the nerves, cut through the vertebral arteries as they wind round the upper part of the spinal cord. Lastly, cut across the spinal cord as low as possible, together with the roots of the spinal nerves that are attached on each side. By placing the first two fingers in the spinal canal, the cord may be raised, and the whole brain may now be taken readily from the skull.

The brain may be examined at once, or it may be immersed in wood-spirit to harden the texture. If the spirit is used, the following plan may be pursued to enable the student to go through the dissection with advantage. To allow the spirit to reach the interior of the ventricles, cut off the upper part of each hemisphere nearly to the level of the corpus callosum, and then open each lateral ventricle by a longitudinal incision of about two inches near the inner margin of the divided hemisphere. Now place the brain upside down on a piece of calico, long enough to wrap over it, and then set it aside in the spirit, with the top of one hemisphere. At the end of one day the dissector should return to the examination of the other membranes and the vessels. As soon as the vessels are learnt, carefully remove the membranes from all the surface of the brain, without detaching the different cranial nerves. Finally, let the brain remain in the spirit till the dissection of the head and neck is completed. The description of the brain will be found after that of the head and neck. How to preserve and examine the brain.

Dissection. — After setting aside the brain, proceed with the anatomy of the dura mater, and the vessels and nerves in the base of the skull. Let the head be raised to a convenient height, and the tentorium be fastened in its natural position with a few stitches. The dissector should be furnished with the base of the skull, whilst studying the following parts. Dissection.

At the base of the cranium the dura mater is much more closely united to the bones than it is at the top of the skull. Here it dips into the different inequalities on the surface of the bones, sends processes through the several apertures, and Dura mater in base of skull;

its prolongations furnishes sheaths to the nerves. Beginning the examination in front, the student will find the membrane sending a prolongation into the foramen cæcum, and a series of tubes through the apertures in the cribriform plate. A large process also enters the orbit by the sphenoidal fissure, and a covering *and connections to bone.* is continued on the optic nerve to the eyeball. After lining the sella turcica, the dura mater adheres closely to the basilar process of the occipital bone, and then descends into the spinal canal. Its connection to the margin of the foramen magnum is very firm.

Tentorium cerebelli; The *tentorium cerebelli* is a piece of the dura mater that is interposed almost in a horizontal position between the *its attachments* cerebellum and the posterior part of the cerebrum. Its upper surface is joined by the falx cerebri along the middle, and is hollowed laterally for the reception of the back part of the cerebral hemispheres; whilst its under-surface corresponds to the cerebellum and falx cerebeli. The anterior margin is free, except at the ends, where it is fixed by a narrow slip to each anterior clinoid process. The posterior or attached part is connected to the following bones:—occipital (its transverse groove), inferior angle of the parietal, petrous portion of the temporal (upper border), and posterior *and the sinuses in it.* clinoid process of the sphenoid. Along the centre of the tentorium is the straight sinus, whilst in the attached edge are the lateral and the superior petrosal sinuses.

Falx cerebelli The *falx cerebelli* has the same position below the tentorium as the falx cerebri above that fold. It is much smaller than the like process of the cerebrum, and will be seen by detaching the tentorium. Triangular in form, this fold is attached to the middle of the occipital bone, below the transverse ridge, and projects between the hemispheres of the cerebellum. Its base is directed to the tentorium, and the *contains occipital sinuses.* apex ends below, at the foramen magnum, to each side of which it gives a small slip. In it are contained the occipital sinuses.

Sinuses of the skull. The SINUSES of the dura mater are venous spaces between the layers, into which the blood is received. All the sinuses open either into a large space opposite the occipital protuberance (torcular Herophili), or into the cavernous sinus, by the side of the body of the sphenoid bone.

A. The TORCULAR HEROPHILI is placed in the tentorium, opposite the centre of the occipital bone. It is of an irregular shape, and numerous sinuses open into it; viz. the superior longitudinal, the straight and inferior longitudinal, the occipital and lateral sinuses. Occipital centre receives

The *superior longitudinal sinus* has been already described (see p. 9.). Superior longitudinal.

The *inferior longitudinal sinus* resembles a small vein, and is contained in the lower border of the falx cerebri at its posterior part. This vein receives blood from the falx and the larger brain, and ends in the straight sinus at the edge of the tentorium. Inferior longitudinal.

The *straight sinus* lies along the middle of the tentorium, and seems to continue the preceding sinus to the common point of union. Its form is triangular, like the superior longitudinal. Joining it are the inferior longitudinal sinus and the veins of Galen, also some small veins from the upper part of the small brain. Straight sinus.

The *occipital sinus* is a small space in the falx cerebelli, which reaches to the foramen magnum, and collects the blood from the occipital fossæ. This sinus may be double. Occipital sinus

The *lateral sinus* is the channel by which the blood passes from the skull. There is one on each side, right and left, which extends from the occipital protuberance to the foramen lacerum jugulare, where it ends in the internal jugular vein. In this extent the sinus corresponds to the winding groove in the interior of the skull, between the two points of bone before mentioned. Besides small veins from the brain, the sinus is joined by the superior petrosal sinus, opposite the upper border of the petrous portion of the temporal bone, and by the inferior petrosal at the foramen lacerum. Oftentimes it communicates with the occipital vein through the mastoid foramen. The right sinus is commonly larger than the left. Lateral sinus. Position to bone. Sinuses joining it.

The foramen lacerum jugulare is divided into three compartments, by bands of the dura mater; through the posterior passes the lateral sinus, through the anterior space the inferior petrosal sinus, and through the central one the divisions of the eighth nerve. Situation in foramen lacerum.

Dissection. — To open the cavernous sinus, say on the left side, Dissection.

make an incision along the side of the sphenoid bone, from the anterior to the posterior clinoid process, and internal to the third nerve. Behind the last-named process, direct the knife inwards for about half the width of the basilar part of the occipital bone. By placing the handle of the scalpel in the opening thus made, the extent of the space will be manifest. A probe should be passed into the different sinuses that join the cavernous sinus.

Cavernous sinus

B. The CAVERNOUS SINUS has been so named from the reticulate structure in its interior. This space, resulting from the separation of the layers of the dura mater, is of an irregular shape, and extends from the sphenoidal fissure to the tip of the petrous portion of the temporal bone. Externally, the piece of dura mater bounding the sinus is of some thickness, and contains in its substance the third and fourth nerves, with the orbital division of the fifth. The cavity of the sinus is larger behind than before, and in it are shreds of fibrous tissue with small vessels. Through the space winds the trunk of the internal carotid artery, with the sixth nerve on the outer side of the vessel; but these are shut out from the blood in the space by a thin lining membrane. The cavernous sinus receives the ophthalmic vein of the orbit, and some small cerebral veins. It communicates with its fellow on the opposite side by the circular and transverse sinuses, and its blood is transmitted to the lateral sinus by the superior and inferior petrosal channels.

has nerves in outer wall; contains carotid artery and sixth nerve; and communicates with following sinuses, viz.

Circular sinus,

The *circular sinus* lies around the pituitary body, and reaches from one cavernous sinus to the other across the middle line. Besides serving as the means of communication between those sinuses, it receives small veins from the pituitary body. This sinus is usually destroyed by the removal of the pituitary body.

Transverse sinus,

The *transverse* or *basilar sinus* crosses the basilar process of the occipital bone, on a level with the petrous part of the temporal bone; through it the cavernous sinuses are joined. A second transverse sinus is sometimes found nearer the foramen magnum.

Superior petrosal,

The *superior petrosal sinus* lies in a groove in the upper margin of the petrous part of the temporal bone, and extends between the cavernous and lateral sinuses. A small vein from the cerebellum is received into it.

The *inferior petrosal sinus* likewise extends between the same sinuses as the preceding, and lies along the line of junction of the petrous part of the temporal with the basilar process of the occipital bone; it is joined by a small vein from the outside of the skull, through the foramen lacerum medium at the base of the cranium. The sinus passes through the jugular foramen in the anterior compartment of that space, and ends in the lateral sinus, as this is about to become the internal jugular vein. Inferior petrosal.

MENINGEAL ARTERIES. — The arteries that supply the dura mater are found in all three fossæ of the base of the skull, and may be accordingly named anterior, middle, and posterior. Arteries of dura mater are,

a. The *anterior meningeal* are very small branches which are derived from the ethmoidal arteries: they are distributed to the dura mater, near the ethmoid bone. Anterior meningeal.

b. The *middle* or *large meningeal branch* of the internal maxillary artery enters the skull by the foramen spinosum of the sphenoid bone, and ascends towards the anterior inferior angle of the parietal bone. At this spot the vessel enters a deep groove in the bone, and ends in ramifications that spread over the side of the head, some of these reaching to the top, and others towards the occiput. Two veins run with this artery. Middle meningeal from internal maxillary,

Branches. — Before the artery enters the skull it gives off the *small meningeal branch*, which is transmitted through the foramen ovale to the middle fossa. As soon as it enters the cranial cavity, it furnishes branches of distribution to the dura mater and osseous structure, and the ganglion of the fifth nerve. One small branch, *petrosal*, enters the hiatus Fallopii, and extends through the aqueduct of the same name till it meets the stylo-mastoid artery. One or two branches also enter the orbit, and anastomose with the ophthalmic artery. gives branches to dura mater and ear;

Another *meningeal branch* from the ascending pharyngeal artery, appears in the middle fossa of the skull, after passing through the foramen lacerum medium basis cranii. and from ascending pharyngeal.

c. The *posterior meningeal branches* are likewise small, and are furnished by the occipital and vertebral arteries. Those from the occipital (one on each side) enter the skull by the jugular foramen; and those from the vertebral arise opposite the foramen magnum. Both sets ramify in the posterior fossa of the skull. Posterior meningeal.

MENINGEAL NERVES. — The source of the nerves of the dura mater is very uncertain. Some authors describe the Nerves of dura mater.

offsets as coming from the fourth and fifth cranial nerves; whilst others refer their origin to the sympathetic. To make these nerves apparent, it would be necessary to steep the dura mater in diluted nitric acid.

Cranial nerves in base of skull are,

CRANIAL NERVES. — The cranial nerves consist of nine pair, and pass from the skull by the apertures in its base. As each leaves the cranium it is invested by processes of the membranes of the brain, which are thus disposed: those of the dura mater and pia mater are lost on the nerve; whilst that of the arachnoid membrane passes but a short distance before it is reflected back to the skull. Some of the nerves, those in the middle fossa of the skull for instance, are received into sheaths of the dura mater before they approach the foramina of transmission. Only part of the course of these nerves will be now seen, the rest is learnt in the dissection of the base of the brain.

Olfactory nerve.

The FIRST NERVE ends anteriorly in the enlargement of the olfactory bulb. This swelling lies on the cribriform plate of the ethmoid bone, and from it filaments of distribution descend to the nose through the small foramina in the subjacent bone. These delicate nerves are surrounded by prolongations of the membranes of the brain, whose disposition will be noticed in the dissection of the nose.

ends in the nose.

Optic nerve enters the eye.

The SECOND NERVE diverging from its commissure to the eyeball, enters the orbit through the optic foramen: accompanying the nerve is the ophthalmic artery.

Dissection.

Dissection. — To expose the nerves that lie in the outer wall of the cavernous sinus, viz. the third, fourth, and ophthalmic division of the fifth, it will be necessary to remove the sheaths of the dura mater that they receive. Follow outwards also the trunk of the fifth nerve, and take away the dura mater from the surface of its large Gasserian ganglion, on the point of the petrous part of the temporal bone. Trace also the two other large trunks that leave the ganglion, viz. superior and inferior maxillary, to their apertures in the skull.

Motor oculi nerve

The THIRD NERVE enters the wall of the cavernous sinus, near the anterior clinoid process, and is deprived at this spot of its tube of arachnoid membrane. From that point forwards the third is above the other nerves in the wall of

the sinus, till it is about to enter the orbit by the sphenoidal fissure. Near the orbit this nerve is joined by one or two delicate filaments of the cavernous plexus. passes to orbit.

The FOURTH NERVE is the smallest of the nerves in the wall of the sinus. Like the preceding nerve, below which it lies, it courses forwards to the orbit; but as it is about to pass through the sphenoidal fissure it becomes higher than all the other nerves. In the wall of the sinus, the fourth nerve is joined by twigs of the sympathetic, and sometimes it is united with the ophthalmic division of the fifth. Some branches are furnished by it to the dura mater. (Bidder.) Trochlear nerve in the wall of cavernous sinus.

FIFTH NERVE.—The two roots of the fifth nerve pass together through an aperture in the dura mater, into the middle fossa of the base of the skull. Immediately afterwards, the large or sensitive root enlarges in the Gasserian ganglion, whilst the small or motor root passes beneath the ganglion without communicating with it. Trifacial nerve has two roots.

The *ganglion of the root of the fifth nerve* (Gasserian ganglion) is placed in a depression on the point of the petrous part of the temporal bone. The upper surface of the ganglion is closely united to the dura mater, and presents a semilunar elevation, whose convexity looks forwards. Some filaments of the sympathetic enter its inner side, from the plexus on the carotid artery. Gasserian ganglion on large root,

Branches. — From the front of the ganglion proceed the three following trunks: — The ophthalmic nerve is the first and highest, and is destined for the orbit and face. Next in order is the superior maxillary nerve, which leaves the skull by the foramen rotundum, and ends in the face below the orbit. And the last, or inferior maxillary nerve, passes downwards through the foramen ovale to reach the lower jaw, tongue, and face. If the ganglion is raised, the small root will be seen to enter the trunk of the inferior maxillary nerve. gives three branches.

Those branches of the ganglion that are unconnected with the small or motor root, viz. the ophthalmic and superior maxillary, are nerves of sensation; but the inferior maxillary is a nerve of sensation and of motion, like a spinal nerve. It is not the whole of the inferior maxillary nerve Difference in the branches.

that so differs from the rest, for the motor root is mixed almost exclusively with that part of the trunk which supplies the muscles of the lower jaw; and therefore it is that small part of the nerve that possesses a double function, and resembles a spinal nerve.

Ophthalmic nerve of ganglion enters orbit

The *ophthalmic nerve* is the only one that needs a more special notice in this stage of the dissection. In form it is a flat band, and it enters the orbit by the sphenoidal fissure. In its course to the orbit, the nerve is contained in the wall of the cavernous sinus, where it lies beneath the third and fourth nerves. In this situation the nerve is joined by filaments of the cavernous plexus, and gives a small *recurrent* filament to that part of the dura mater, which forms the tentorium cerebelli (Arnold).

Supplies dura mater.

Abducens nerve is in cavernous sinus.

The SIXTH NERVE enters the space of the cavernous sinus by piercing the dura mater behind the body of the sphenoid bone, and reaches the orbit through the sphenoidal fissure. In the sinus, the nerve is placed close against the outer side of the carotid artery, where it is joined by one or two branches of the sympathetic nerve surrounding that vessel.

Seventh nerve has two parts.

SEVENTH NERVE.—Both the facial and auditory trunks of this cranial nerve enter the meatus auditorius internus. In the bottom of the meatus they separate; the facial nerve courses through the aqueduct of Fallopius to the surface of the skull, whilst the auditory nerve is distributed to the internal ear.

Eighth nerve has three parts.

EIGHTH NERVE.—The three parts of this nerve pass through the central compartment of the foramen lacerum jugulare, but all are not contained in the same tube of dura mater and arachnoid membrane. The glosso-pharyngeal nerve is external to the other two, being separated from them by the inferior petrosal sinus, and has distinct sheaths of the dura mater and arachnoid membrane. But the pneumogastric and spinal accessory nerves are inclosed in the same tube of the dura mater, a piece of the arachnoid only intervening between them.

Their passage through foramen lacerum.

The NINTH NERVE consists of two small pieces that pierce separately the dura mater opposite the anterior condyloid foramen, and unite after passing through that aperture.

Dissection. — The dissector may now return to the examination of the trunk of the carotid artery, as it winds through the cavernous sinus. Dissection of carotid,

On the opposite side, viz. that on which the nerves in the wall of the cavernous sinus are untouched, an attempt may be made to expose the small plexuses of the sympathetic on the carotid artery. It will be necessary to cut off the anterior clinoid process, and to dissect out with care the third, fourth, fifth, and sixth nerves. Small filaments pass from the plexuses to these nerves. In an injected body this dissection is scarcely possible. of sympathetic.

The INTERNAL CAROTID ARTERY appears in the base of the skull at the apex of the petrous part of the temporal bone. In its ascent to the brain, the vessel lies along the side of the body of the sphenoid bone, and makes two remarkable bends (like the letter S reclined) in the space of the cavernous sinus. On entering the sinus, the artery ascends, at first, to the posterior clinoid process; it is then directed forwards to the root of the anterior process of the same name; and lastly, it turns upwards internal to this point of bone, perforates the dura mater a second time, and divides into cerebral arteries at the fissure of Sylvius. In this course the artery is enveloped by nerves derived from the sympathetic in the neck. Internal carotid artery winds through cavernous sinus.

The *branches* of this part of the artery are few. In the sinus there are some small arteries (arteriæ receptaculi) to the dura mater; and opposite the anterior clinoid process the ophthalmic *branch* arises. The terminal branches of the carotid, at the base of the brain, will be seen in the dissection of that part. The branches are to dura mater and orbit.

SYMPATHETIC NERVE. — Around the carotid artery is a prolongation of the sympathetic nerve of the neck, which forms the following plexuses: — Sympathetic on carotid forms

a. The *carotid plexus* is situate on the outer side of the vessel, at its entrance into the cavernous sinus, and communicates with the sixth nerve, the Gasserian ganglion, and the spheno-palatine ganglion. carotid plexus.

b. The *cavernous plexus* is placed below the bend of the artery, which is close to the root of the anterior clinoid process. This small plexus is more immediately connected with the offset of the sympathetic, that courses along the inner side of the carotid artery. cavernous plexus.

Union with cranial nerves. Filaments are given from this plexus to unite with the third, fourth, and ophthalmic nerves. One filament is also furnished to the lenticular ganglion, either separately from, or in conjunction with the nasal nerve. Other branches of distribution surround the trunk of the carotid, and are lost on the cerebral arteries.

Two petrosal nerves in base of skull. *Petrosal nerves.* — Beneath the Gasserian ganglion is the *large superficial petrosal nerve*, entering the hiatus Fallopii. External to this is occasionally seen another small *petrosal* nerve (nervus petrosus superficialis tertius, Bidder), which springs from the sympathetic on the middle meningeal artery, and enters the bone to join the facial nerve with the preceding. A third *petrosal* nerve is contained in the substance of the temporal bone.

Section III.

THE FACE.

Position of body. The previous position of the body for the examination of the base of the skull will require to be changed. The head is to be lowered, and the side of the face to be examined is to be placed upwards. On the left side the dissector will expose the muscles and vessels, and the right side he is to reserve for the nerves.

Dissection *Dissection.* — As a preparatory step, make tense the fibres of the eyelids, lips, and side of the nose, by inserting a little tow or cotton wool into the different apertures; then fasten the margins of the eyelids and lips with a few sutures. Divide the integuments on the left side of the face by an incision in front of the ear, from above the zygoma to the angle of the jaw, and continued from the last point along the base of the jaw to the chin. Raise the flap of integument from without inwards, and leave it adherent along the middle line. Much care must be taken in detaching the skin from the thin, and oftentimes pale fibres of the orbicular muscle of the eyelids, otherwise these will be destroyed in consequence of the little fat that intervenes between the two. On the side of the nose the skin is closely united to the subjacent parts, and must be detached with care. Around the mouth are many fleshy slips that extend both upwards and downwards from the orbicular muscle, but they are all marked so distinctly as to escape injury, except the small risorius muscle that comes from the angle of the lower jaw towards the corner of the mouth. When removing the fat from the

(Margin notes: of muscle of eyelid, side of nose, and around mouth.)

muscles, each fleshy slip should be made tense by means of hooks. The facial vessels and their branches will come into view as the parts are cleaned; but the nerves may be disregarded on this side. Near the ear is the parotid gland, whose duct is on a level with the meatus auditorius, and pierces the middle of the cheek.

MUSCLES OF THE FACE.—The superficial muscles of the face are gathered around the apertures of the eye, nose, and mouth. An orbicular or sphincter muscle surrounds the aperture both of the eye and mouth; and other muscles are blended with it to enlarge each aperture. There are three distinct sets of muscles: one of the opening of the eyelids; another of the nostril; and a third of the aperture of the mouth. One of the muscles of mastication, viz. the masseter, is also now seen, but it will be afterwards examined.

In the face the muscles surround the apertures.

The *muscles of the eyelids* are four in number, viz. orbicularis palpebrarum, corrugator supercilii, levator palpebræ superioris, and tensor tarsi. The two latter are dissected in the orbit, and will be described with that part.

Four muscles of eyelids.

The ORBICULARIS PALPEBRARUM is the sphincter muscle of the elliptical opening between the eyelids. It is a flat and thin layer, which extends from the margin of the lids to beyond the circumference of the orbit. At the inner angle of the orbit the muscle is fixed to the internal angular process of the frontal bone, and to the nasal process of the superior maxillary bone; also to the borders of a small tendon (tendo palpebrarum), and to the anterior margin of the groove for the lachrymal sac. From this origin the fibres are directed above and below the aperture of the lids, giving rise to ovals, which increase in size towards the outer margin of the muscle. The external fibres (orbital) are the strongest, and project beyond the margin of the orbit; the internal fibres (ciliary) are very pale and thin, and form a small bundle close to the cilia or eyelashes; whilst the fibres which occupy the eyelids (palpebral) are intermediate in size. The muscle is subcutaneous, and its circumference is free, except above, where it is blended with the occipito-frontalis. Beneath the upper half of the orbicularis, as it lies on the

Orbicularis palpebrarum arises internally,

and consists of three sets of fibres.

Connection with parts around.

margin of the orbit, is the corrugator supercilii muscle with the supra-orbital vessels and nerve, and beneath the lower half is part of the elevator of the upper lip.

Corrugator supercilii is blended with orbicularis.

The CORRUGATOR SUPERCILII is found beneath the orbicularis, near the inner angle of the orbit. Its fibres *arise* from the inner part of the superciliary ridge of the frontal bone, and are directed thence outwards to join the orbicular muscle about the middle of the orbital arch. It is a short muscle, and is distinguished by the closeness of its fibres.

Four muscles of nose.

The *muscles of the nose* are the following: pyramidalis nasi, compressor naris, levator alæ nasi, and depressor alæ nasi.

Pyramidalis nasi is over nasal bone.

The PYRAMIDALIS NASI is a small pyramidal slip that covers the nasal bone, and appears to be a prolongation of the occipito-frontalis muscle. Its fibres end in an aponeurosis, which joins that of the compressor naris over the cartilaginous part of the nose. By the outer border the muscle is united with the orbicularis palpebrarum, and along the inner border is the muscle of the opposite side.

Compressor naris covers cartilage of nose.

COMPRESSOR NARIS.—This muscle is not well seen till after the examination of the following one. Triangular in shape it *arises* by a point from the canine fossa of the upper maxillary bone. The fibres are directed inwards, spreading out at the same time, and end in an aponeurosis, which covers the cartilaginous part of the nose, and joins the tendon of the opposite muscle as well as the nasal cartilage. This muscle is partly concealed by the common elevator of the ala of the nose and the upper lip.

Elevator of wing of nose is part elevator of upper lip.

The LEVATOR LABII SUPERIORIS ALÆQUE NASI is placed by the side of the nose, and *arises* from the nasal process of the upper maxillary bone, below the orbicularis. As the fibres descend from the inner part of the orbit, the most internal are attached by a narrow slip to the wing of the nose, whilst the rest are blended inferiorly with those of the orbicularis oris. The origin of the muscle is concealed by the orbicularis palpebrarum; in the rest of its extent the muscle is subcutaneous.

Depressor of wing is

The DEPRESSOR ALÆ NASI is found beneath the mucous membrane on the side of the frænum of the upper lip. It

arises below the nose from a depression of the upper jaw-bone near the incisor teeth, and ascends to be *inserted* into the septum and posterior part of the ala of the nose. seen from mouth.

Muscles of mouth.

The *muscles that act on the aperture of the mouth* consist of a sphincter; an elevator of the upper lip, and of the angle of the mouth; depressors of the lower lip, and angle of the mouth, and an elevator of the lower lip; together with other small muscles that act on the corner, viz. zygomatici and risorius of Santorini. Lastly, the buccinator muscle may be reckoned in this set, as it acts on the mouth.

Sphincter of mouth without bony attachment.

The ORBICULARIS ORIS MUSCLE surrounds the aperture of the mouth with elliptical fibres, like the sphincter muscle of the eyelids. The muscle has not an attachment to bone, but at the corners of the mouth the fibres are blended with, or continued into those of the other muscles that are there inserted, especially the buccinator. The inner margin of the muscle is free, and bounds the aperture of the mouth; whilst to the outer edge are united the different muscles that elevate or depress the lips and the angle of the mouth. Beneath the orbicularis in each lip is the coronary artery.

Blends with other muscles.

Elevator of upper lip passes from the orbit to mouth.

The LEVATOR LABII SUPERIORIS extends vertically from the lower margin of the orbit to the orbicularis oris. It *arises* from the upper maxillary and malar bones, above the infra-orbital foramen, and is *inserted* into the orbicularis oris, between the middle line and angle of the mouth. Near the orbit the muscle is overlapped by the orbicularis palpebrarum, but below that spot it is subcutaneous. To its inner side is the common elevator of the ala of the nose and the upper lip, and to its outer side the zygomatic muscles. Beneath it are the infra-orbital vessels and nerve.

Elevator of the angle mixes with depressor of angle.

The LEVATOR ANGULI ORIS has well-marked fibres, and is partly concealed by the preceding muscle. Arising from the canine fossa, beneath the infra-orbital foramen, its fibres spread out towards the angle of the mouth, where they mix with the rest of the muscles, but the greater number are continued into the depressor anguli oris. This muscle is deep at its origin beneath the elevator of the upper lip, but it soon passes from beneath that muscle.

Depres-

The DEPRESSOR LABII INFERIORIS is opposite the elevator of

sor of lower lip is in the middle of chin.

the upper lip, and much yellow fat is mixed with its fibres. The muscle takes its *origin* from the front of the lower jaw, and ascends to be blended with the orbicularis in the lower lip. The inner border of the depressor is contiguous to the muscle of the opposite side, and the outer is overlapped by the depressor anguli oris.

Depressor of angle is a strong muscle.

The DEPRESSOR ANGULI ORIS is triangular in shape, and passes from the oblique line on the outer surface of the lower jaw to the angle of the mouth, where its fibres are continued into the elevator of the angle. This muscle conceals the labial branch of the inferior dental vessels and nerve. At its origin the depressor is united with the platysma myoides, and at its insertion with the risorius muscle.

Elevator of chin is seen inside mouth.

The LEVATOR MENTI is a small muscle on the side of the frænum of the lower lip, and it corresponds to the depressor of the ala of the nose in the upper lip. When the mucous membrane is removed this muscle is seen to *arise* from a fossa near the symphysis of the lower jaw, and to descend to its *insertion* into the integument of the chin. Its position is internal to the depressor of the lip.

Zygomatic muscles;

The ZYGOMATIC MUSCLES are directed obliquely from the arch of the same name towards the angle of the mouth. One is longer and larger than the other; hence the names major and minor.

large

a. The *zygomaticus major* arises from the outer part of the malar bone near its union with the temporal, and is inserted into the angle of the mouth.

and small: last may be absent.

b. The *zygomaticus minor* is attached to the malar bone anterior to the other, and is blended more frequently with the fibres of the elevator of the upper lip, than with the orbicularis at the angle of the mouth.

Risorius muscle is almost transverse.

The RISORIUS MUSCLE (Santorini) is a narrow bundle of fibres, sometimes divided into two or more parts, which arises externally from the fascia over the masseter muscle, and is connected internally with the apex of the depressor anguli oris.

Buccinator muscle. Origin.

The BUCCINATOR is a thin flat muscle, that occupies the interval between the jaws, and bounds the cavity of the mouth in that direction. Superiorly and inferiorly the

muscle *arises* from the outer surface of the upper and lower maxillæ, as far forward as the first molar tooth, and in the interval between the jaws it is attached to the band of the pterygo-maxillary ligament. From this origin the fibres are directed forwards to the angle of the mouth, where they mix with the orbicularis; and as some fibres descend to the lower lip whilst others ascend to the upper lip, a decussation takes place at the angle of the mouth. On the cutaneous surface of the buccinator are the different muscles that converge to the angle of the mouth; and crossing the upper part is the duct of the parotid gland, which perforates the muscle opposite the second upper molar tooth. Internally the muscle is lined by the mucous membrane of the mouth. By the intermaxillary origin the buccinator corresponds to the attachment of the superior constrictor of the pharynx.

Insertion at corners of mouth.

Parts in contact with it.

The VESSELS OF THE FACE consist of the facial and transverse facial arteries with their accompanying veins. The arteries are branches of the external carotid, and the facial vein is received into the internal jugular trunk.

Arteries of the face.

The *facial artery* emerges from the neck, and appears on the lower jaw, anterior to the masseter muscle. From this point the artery ascends in a tortuous manner near the angle of the mouth and the side of the nose to the inner angle of the orbit, where it anastomoses with the ophthalmic artery. The course of the vessel is comparatively superficial, though lying in the mass of fat of the inner part of the cheek, and is crossed by some of the muscles of the face. At first the artery is concealed by the platysma whilst crossing the jaw, but this thin muscle does not prevent pulsation being recognised during life; and near the mouth the zygomatic muscle is superficial to it. The vessel rests successively on the lower jaw, buccinator muscle, elevator of the angle of the mouth, and that of the upper lip. Accompanying the artery is the facial vein, which is nearly a straight tube, and lies to its outer side.

Facial artery;

course,

and connections.

Branches. — From the outer side of the vessel unnamed branches are furnished to the muscles and integuments, some of which anastomose with the transverse facial artery. From the inner side are given the following branches: —

Plan of the branches.

Inferior labial.

1. The *inferior labial branch* runs inwards beneath the depressor anguli oris muscle, and is distributed between the lower lip and chin; it anastomoses with the inferior coronary, and with the labial branch of the inferior dental artery.

Two coronary form an arch in each lip.

2. *Coronary branches.*—There is one for each lip (superior and inferior), which arise together or separately from the facial, and are directed inwards between the orbicular muscle and the mucous membrane of the lip, till they inosculate with the corresponding branches of the opposite side. From the arterial arches thus formed, offsets are supplied to the lips and labial glands.

Branch to nose.

From the arch in the upper lip a branch is given to the septum of the nose (artery of the septum).

Lateral nasal branch.

3. The *lateral nasal branch* arises opposite the ala of the nose, and passes beneath the levator labii superioris alæque nasi, to be distributed on the side of the nose, where it anastomoses with the nasal branch of the ophthalmic artery.

Angular branch.

4. The *angular branch* is the terminal twig of the facial artery at the inner angle of the orbit, and anastomoses with a branch of the ophthalmic artery.

Facial vein is away from artery;

The *facial vein* commences at the root of the nose by a small vein named angular. It then crosses over the elevator of the upper lip, and separating from the artery courses beneath the zygomatic muscles to the side of the jaw. Afterwards it has a short course in the neck to join the internal jugular vein.

is joined by branches.

Branches.—At the inner side of the orbit it receives veins from the lower eyelid (inferior palpebral) and the side of the nose. Below the orbit it is joined by the infra-orbital vein, by a large branch that comes from the pterygoid region (alveolar branch), and thence to its termination by veins corresponding to the branches of the artery both in the face and neck.

Transverse facial artery.

The *transverse facial* is a branch of the temporal artery, and it appears in the face at the anterior border of the parotid gland. It lies along the parotid duct, with branches of the facial nerve, and distributes offsets to the muscles and integuments; some branches anastomose with the facial artery.

Dissection.

Dissection.—Expose now the parotid gland. To see the gland, raise the skin from its surface towards the ear by means of an incision from the base of the jaw to the anterior border of the sternomastoid muscle; this cut may be united with that made for the dissection of the posterior muscle of the ear. A strong fascia covers the gland, and is connected above and behind to the

zygoma and cartilage of the ear, but in front is continued over the face. After the fascia is removed, the superficial connections of the gland will appear. The great auricular nerve is seen ascending to the lobe of the ear.

The PAROTID, so named from its position, is the largest of the salivary glands, and it occupies the space between the ear and the lower jaw. Its excretory duct enters the mouth through the middle of the cheek. Parotid gland.

The shape of the gland is irregular, and is determined somewhat by the bounding parts. Thus inferiorly, where there is not any resisting structure, the gland projects into the neck, and comes into close proximity with the submaxillary gland, though separated from it by a process of the cervical fascia. A line from the angle of the jaw to the mastoid process marks usually the extent of the parotid in this direction. Above and at the posterior part, the gland is limited by the zygoma, temporal bone, and sterno-mastoid muscle. Anteriorly the gland projects somewhat on the face, and has a small accessory part, *socia parotidis*, prolonged from it over the masseter. Irregular in shape; is lodged between the jaw and ear; accessory part.

Connected with the anterior border is the excretory duct (duct of Stenson), which crosses the masseter below the *socia parotidis*, and perforates the buccinator muscle opposite the second molar tooth of the upper jaw. The duct lies between the transverse facial artery and branches of the facial nerve, the latter being below it. A line drawn from the meatus auditorius to a little below the nostril would mark the level of the duct, and the central point of the line its opening into the mouth. The length of the duct is about two inches, and its capacity is about equal to a large ? crow-quill, but the opening into the mouth is only large enough to allow a small probe to pass. The duct crosses side of face to reach mouth. Its length and size.

The cutaneous surface of the parotid is smooth, and has one or two lymphatic glands seated on it, but the deep part sends processes into the inequalities of the space between the jaw and the mastoid process. Cutaneous surface of gland.

Dissection.—By removing with care the parotid gland, the hollows that it fills up will come into view: at the same time the dissector will see the vessels and nerves that pass through the Dissection.

gland. An examination of the processes of the gland, and the number of important vessels that are in relation with it, will demonstrate the impossibility of removing this body, and the dangers attending any operation on it. The duct may be opened now, and a probe passed along it to the mouth to show the diminished size of its aperture.

Deep surface sinks behind jaw.

Two large processes of the gland extend deeply into the neck. One dips behind the styloid process, and projects beneath the mastoid process and sterno-mastoid muscle, whilst it reaches also the deep vessels and nerves of the neck. The other piece is situate in front of the styloid process; it reaches behind the articulation of the lower jaw, and beneath the ramus of that bone along the internal maxillary artery.

Vessels and nerves in the gland.

Passing through the middle of the gland is the external carotid artery, which ascends behind the ramus of the jaw, and furnishes the transverse facial, auricular, superficial temporal, and internal maxillary branches. Superficial to the artery is the trunk formed by the junction of the temporal and internal maxillary veins, from which the external jugular springs; and opening into this common trunk are some veins from the parotid, whilst a branch through the gland connects it with the internal jugular vein. Crossing the gland from behind forwards is the trunk of the facial nerve, which distributes its branches through the parotid. The superficial temporal branch of the inferior maxillary nerve likewise passes through the upper part of the glandular mass.

The gland formed by termination of the ducts,

The *structure* of the parotid resembles that of the other salivary glands. The glandular mass is divided into numerous small lobules by intervening processes of fascia, and each lobule consists of a set of the terminal ramifications of the excretory duct, which end in closed extremities, and are surrounded by capillary vessels. The size of the ducts, which by their aggregation form the mass of the lobule, is about $\frac{1}{1200}$ of an inch in diameter. From the lobules issue small ducts, which unite to form larger tubes, and finally all the ducts of the gland are collected into one. An examination of the common duct (duct of Stenson) will show it to be composed of an external fibrous or contractile coat, and an internal mucous coat which is covered with columnar epithelium.

and the duct has two coats.

The parotid receives its arteries from the external carotid, and its nerves from the sympathetic, facial, and great auricular. The lymphatics join those of the neck. Vessels and nerves.

Two or three small glands (*molar*) lie along the origin of the buccinator, and open into the mouth near the last molar tooth by separate ducts. Molar glands.

CARTILAGES OF THE NOSE.—These close the nasal aperture which exists in the skeleton, and form part of the septum nasi; they are five in number, two on each side (lateral cartilage and cartilage of the aperture), together with a central one, or cartilage of the septum of the nose. Only the lateral cartilages are seen in this stage of the dissection. Nasal cartilages.

Dissection.—To expose the lateral cartilages take away all the muscular and cellular structure from the left side of the nose, and remove the skin from the lower part of the nostril of the same side. By passing the knife deeply in the middle line, the cartilage of the septum will be seen to project between the lateral cartilages of each side. Dissection.

The *upper lateral cartilage* is flattened, and is somewhat triangular in form. Posteriorly it is attached to the nasal and superior maxillary bones, and anteriorly it touches the one of the opposite side for a short space; but the two are separated below by an interval, in which appears the cartilage of the septum. Inferiorly the lateral cartilage is contiguous to the cartilage of the aperture, and is connected to it by fibrous tissue. The upper cartilage touches its fellow in the middle.

The *cartilage of the aperture* forms nearly a ring around the nostril, which it keeps always open; a piece extending both on the outer and inner sides of that aperture. This cartilage has not any attachment directly to bone, but is united superiorly to the lateral cartilage by fibrous tissue and inferiorly it is connected with the dense structure that forms the lower margin of the aperture of the nostril. The *outer part* of the cartilage bounds the nostril externally; it is narrow and pointed behind, but swells out in front, and forms with its fellow the prominence of the apex of the nose. The *inner part* projects backwards along the septum of the nose, nearly to the superior maxillary bone; this part The lower cartilage surrounds aperture. One par outside; another inside nostril.

assists in the formation of the partition between the nostrils, and lies below the level of the septum nasi.

Acces-sory car-tilages. Behind the outer half of the cartilage of the aperture, in the dense tissue that fixes it to the bone, are two or three small pieces of cartilage (cartilagines minores vel sesamoideæ), which seem to result from the breaking up of the posterior extremity of the cartilage of the aperture.

Acces-sory parts of the eye. The APPENDAGES OF THE EYE consist of the eyebrow, the eyelid, and the lachrymal apparatus. These parts can be seen now on the opposite side of the face; but the apparatus for the tears will be dissected after the orbit is completed.

Eye-brow. The *eyebrow* (supercilium) is a curved eminence just above the eye, which corresponds to the orbital arch of the frontal bone. Each consists of thickened integument with subjacent fat, and its prominence is due to the orbicularis palpebrarum. Each is furnished with long coarse hairs, that are directed outward.

Eyelids. The *eyelids* are two semilunar folds in front of the eyeball. When the lids are open there is an interval (fissura palpebrarum) between them, and when they are closed the upper lid (which is the largest) descends below the middle of the eyeball. Externally and internally they are united by a commissure or *canthus*. The free margin of each is thicker than the rest of the lid, and presents towards the inner side a small elevation, in which is the *punctum lachrymale*, or the opening of the canal for the tears. This margin is provided with hairs (cilia), and is sloped obliquely from before backwards, so as to leave a space in front of the eyeball when the lids are closed. Behind the eyelashes are the openings of the Meibomian glands. Both the cilia and the Meibomian glands are absent from the part of the lid which is internal to the opening of the lachrymal canal.

Upper the largest.

Free margin has hairs and aper-tures,

except at inner part.

Eye-lashes. The *eyelashes* (cilia) are two or more rows of long hairs, which are fixed into the anterior edge of the free border of the lid; they are largest in the upper lid, and diminish in length from the centre towards the sides. The cilia are so arranged as to be convex towards one another.

Differ-ent parts in eye-lids. STRUCTURE OF THE EYELIDS.—Each lid consists of integument, of a layer of fibres of the orbicularis palpebrarum,

of the palpebral ligament and tarsal cartilage, with a mucous lining of the conjunctiva. The upper lid has also in it the tendon of the levator palpebræ. Vessels and nerves are furnished to these parts.

Dissection. — Examine the structure of the lids on the side on which the muscles are dissected. Let the bit of tow or wool remain beneath the lids, and then throw inwards the palpebral part of the orbicularis palpebrarum by means of an incision around the margin of the orbit. In raising the muscle, take care of the palpebral ligament, and the vessels and nerves of the lids. Dissection.

Orbicularis palpebrarum. — The palpebral and ciliary fibres of this muscle form the thin pale layer that occupies the eyelids. A thin stratum of cellular tissue, without fat, connects the muscle with the skin. Layer of orbicularis.

The *palpebral ligament* is a layer of fibrous membrane, that is continued from the margin of the orbit to join the tarsal cartilages. At the inner part of the orbit the ligament is thin and loose, but at the outer part it is much thicker and stronger. A fibrous layer.

The *tarsal cartilages* are two fibro-cartilaginous plates, one for each eyelid, which give the form and strength to the lids. They are fixed internally by the tendo palpebrarum, and externally by fibrous bands (external tarsal ligament) to the outer part of the orbit. One margin is free and thicker than the rest of the cartilage, whilst the opposite margin is thin, and is connected with the palpebral ligament. On the inner surface the cartilages are lined by the mucous membrane or conjunctiva. The cartilages are not alike in the two lids. In the upper eyelid, in which the cartilage is the largest, it is about half an inch wide in the centre, but gradually tapers to the ends; and to its upper convex border is attached the tendon of the levator palpebræ. In the lower lid the cartilage is a narrow band, about two lines broad, with borders nearly straight. Fibro-cartilage forms part of the lid. Difference in the two lids.

Tendon of the eyelids (tendo palpebrarum, tendo oculi) is a small band at the inner part of the orbit, which is attached to the anterior margin of the lachrymal groove. It is about two lines long, and divides into two processes, which are united with the tarsal cartilages. This tendon gives a Tendon of eyelids attaches cartilages.

fibrous expansion to the lachrymal sac, and the fleshy fibres of the orbicularis palpebrarum arise from it.

Follicular tubes beneath cartilage, The *Meibomian glands* or follicles are placed on the ocular surface of the tarsal cartilages, which are grooved for them. They extend parallel to one another, from the thick to the thin margin of the cartilage; and their number is about forty in the upper, and twenty in the lower lid. their structure. The apertures of the glands are at the posterior edge of the free border of the lid. Each gland is a small yellowish tube, closed at one end, and having minute lateral appendages connected with it. Each contains a sebaceous secretion, and is lined by scaly epithelium.

Tendon of levator palpebræ. If the palpebral ligament is cut through in the upper lid, the tendon of the levator palpebræ will be seen to be attached to the upper part of the tarsal cartilage by a wide tendinous expansion.

Mucous lining of lid The *conjunctiva*, or mucous membrane, lines the interior of the eyelids, and covers the anterior part of the ball of the eye. At the free margin of the eyelids this membrane joins the common integument, and it is continued down the lachrymal canals and lachrymal sac to the interior of the nose. forms caruncle At the inner commissure of the eyelids the conjunctiva forms a prominent, red, fleshy-looking body (*caruncula lachrymalis*), which encloses a group of mucous follicles. and the contiguous fold. On this eminence are a few minute hairs. External to the caruncle is a small fold of the mucous membrane (*plica semilunaris*), which extends to the ball of the eye, and resembles the membrana nictitans of birds.

Arteries of lids. *Bloodvessels of the eyelids.* — The *arteries* of the eyelids are furnished by the ophthalmic artery, and consist of the palpebral and lachrymal branches.

Palpebral The *palpebral arteries*, one for each eyelid, run outwards from the inner canthus, lying between the orbicularis muscle and tarsal cartilage, and anastomose with the lachrymal artery. From the arch that each and lachrymal. forms, branches are distributed to the eyelids. The *lachrymal artery* perforates the palpebral ligament near the outer part of the orbit, and its branches supply the lid, as well as anastomose with the palpebral branches.

Veins. The *veins* of the lids open into the frontal and angular veins at the root of the nose.

The NERVES OF THE EYELIDS are supplied from the ophthalmic and facial nerves. Nerves of lids

The branches of the ophthalmic nerve (of the fifth) that enter the upper eyelid are the following:—*lachrymal*, near the outer part; *supra-orbital*, about the middle; and *supra-trochlear* and *infra-trochlear* at the inner side. All these nerves give filaments to the structures of the lid. In the lower eyelid, about its middle, is a *branch* of the *superior maxillary nerve*. The *branches* of the *facial nerve* enter both lids at the outer part, and supply the orbicularis muscle; they also communicate with the branches of the fifth nerve. from fifth and seventh nerve.

EXTERNAL EAR.—The outer ear consists of a trumpet-shaped structure, named pinna or auricle, to collect sounds, and of a tube (meatus auditorius) to convey those sounds to the inner ear. The pinna may be examined on the left side of the head, but the meatus will be described with the rest of the anatomy of the ear. Parts of external ear.

The *pinna*, or *auricle of the ear*, is an uneven piece of cartilage, which is covered with integument, and is fixed to the margin of the meatus auditorius externus. It is of an oval form, with the margin folded, and the larger end placed upwards. Texture and form of pinna.

The surface next the head is convex, but the opposite one is hollowed out, and presents the undermentioned elevations and depressions. In the centre of the ear is a deep hollow (*concha*), which conducts to the meatus auditorius. In front of that hollow is a cartilaginous projection of a triangular shape (*tragus*), which has some hairs on the under-surface; and on the opposite side of the hollow, rather below the level of the tragus, is another projection, the *antitragus*. The round, rim-like margin of the ear is called the *helix*, and the depression internal to it, the groove, or fossa of the helix. Within the helix, between it and the concha, is the large eminence of the *antihelix*, which presents at the upper part a well-marked depression, the fossa of the antihelix. Inferiorly, the external ear is terminated by a soft, pendulous part, the lobule. Surfaces marked by fossæ and eminences.

The *muscles of the pinna*, which extend from one part of the cartilage to another, are very delicate, and in some bodies are not to be found. Five small muscles are usually described, which receive their names for the most part from Five small muscles of external ear.

the several eminences of the external ear, except the antihelix.

Dissection.

Dissection.—In seeking the following small muscles, remove the integument from over the spot on which each muscle is said to be placed. A very sharp knife and a good light are necessary for success in detecting the muscular fibres. Frequently the dissector will not find one or more of the set described below.

One muscle on tragus.

The *muscle of the tragus* is always found on the external aspect of the process from which it takes its name. The fibres are short, nearly vertical, and extend from the lower to the upper part of the tragus.

One from anti-tragus to anti-helix.

The *muscle of the antitragus* is the best marked of all. It arises from the outer part of the antitragus, and the fibres are directed upwards to be inserted into the pointed extremity of the antihelix.

One on root of helix.

The *small muscle of the helix* is often indistinct or absent. It is placed on the part of the rim of the ear, that extends into the concha.

Another higher on helix.

The *large muscle of the helix* arises above the small muscle of the same part, and is inserted into the front of the helix, where this is about to curve backwards. It is usually present.

And one muscle at back of concha.

The *transverse muscle of the auricle* is found at the back of the ear, in the depression between the antihelix and the convexity of the surface. It arises from the convexity of the cartilage that forms the concha, and is inserted into the back of the antihelix. The muscle is mixed with much fibrous tissue, but it is well seen when this is removed.

Dissection.

Dissection.—The pinna may now be removed by cutting it as near as possible to the bone. When the integuments are entirely taken off, the cartilage of the pinna will be apparent: but in removing the integuments, the lobule of the ear, which consists of skin and cellular structure, will disappear.

Cartilage forms only part of external ear.

The *cartilage of the pinna* resembles much the form of the external ear, and presents for notice nearly the same parts. The rim of the helix terminates posteriorly about the middle of the pinna in the antihelix; anteriorly a small piece projects from it, and a fissure is placed above that projection. The antihelix is divided posteriorly into two pieces; one of these is pointed, and is joined by the helix, the other is continued into the antitragus. Inferiorly, the cartilage forms the external part of the auditory canal, and is fixed to the margin of the external auditory aperture in

Deficient inferiorly

and at upper part of meatus.

the temporal bone, but it does not give rise to a complete tube, for the upper and anterior part of the auditory canal is closed by fibrous tissue. On the posterior aspect of the concha is a strong vertical process of cartilage.

Its fissures

In the piece of cartilage that forms the under-part of the meatus are two *fissures* (Santorini); one is at the base of the tragus, the other passes from before backwards.

and ligaments.

The *ligaments* of the pinna are two bands of fibrous tissue that extend between the tragus and helix, and the antitragus and antihelix; the former completes the tube of the meatus.

Outline of facial nerve.

The FACIAL NERVE (portio dura) is a part of the seventh cranial nerve, and confers motor power on the muscles of the face. Numerous communications take place between it and the fifth nerve, and the chief of these junctions are found above and below the orbit, and on the side of the lower jaw.

Dissection of nerve beyond parotid,

Dissection. — On the right side of the face, the facial nerve is to be displayed. To expose its ramifications beyond the parotid gland, raise the skin from the face in the same manner as on the left side. Seek then the different branches of the nerve as they escape from beneath the anterior border of the gland, and follow them forwards to their termination. The highest branches that go to the temple have been already partly exposed above the zygoma; and their junction with the temporal branch of the superior maxillary and with the supra-orbital nerve has been seen. Other still smaller branches are to be traced to the outer part of the eye, where they enter the eyelids and communicate with the other nerves therein; and by means of this set, whilst they cross the malar bone, a junction is formed with the subcutaneous malar nerve. With the duct of the parotid are two or more large branches, that are to be followed below the orbit to their junction with the infra-orbital, nasal, and infra-trochlear nerves. The remaining branches to the lower part of the face are smaller in size: one joins with the buccal nerve at the lower part of the buccinator muscle; and one or two others are to be traced forwards to the lower lip and to the labial branch of the inferior dental nerve.

and of the nerve in the parotid.

In order to trace backwards the trunk of the nerve through the gland, take the integuments from the surface of the parotid as on the other side, and remove the gland piece by piece. In this step seek the small branches of communication of the great auricular nerve with offsets of the facial, and the branches that dip down

from the facial to the auriculo-temporal nerve. Lastly, cut off with a chisel the tip of the mastoid process, and after turning it backwards with the sterno-mastoid muscle adhering to it, seek the small branches of the facial nerve to the back of the ear, and to the digastric and stylo-hyoid muscles.

Branches outside the skull.

THE FACIAL NERVE OUTSIDE THE SKULL.—The facial nerve issues from the stylo-mastoid foramen, after traversing the aqueduct of Fallopius, and furnishes immediately the three following small branches:—

Posterior auricular branch.

The *posterior auricular branch* turns upwards in front of the mastoid process, where it communicates with the auricular branch of the pneumogastric, and ends in auricular and mastoid divisions (p. 7.).

Branch of digastric.

The *branch of the digastric muscle* generally arises in common with the next. It is distributed by many branches to the posterior belly of the muscle near its origin. One of these branches passes through the fleshy fibres, and descends to join the glosso-pharyngeal nerve.

Branch of stylo-hyoid.

The *branch of the stylo-hyoideus* is a long slender nerve, that is directed inwards to its muscle, which it enters about the middle. This branch communicates with the sympathetic nerve on the external carotid artery.

As soon as the facial nerve has given off those branches, it is directed forwards through the gland, and divides near the ramus of the jaw into two large trunks — temporo-facial and cervico-facial.

The upper division

A. The TEMPORO-FACIAL DIVISION furnishes offsets to the side of the head and face, whose ramifications extend as low as the meatus auditorius. As this trunk crosses over the external carotid artery, it sends downwards branches to join the auriculo-temporal division of the inferior maxillary nerve, and in front of the ear it gives some filaments to the tragus of the pinna. Three sets of branches, temporal, malar, and infra-orbital, are derived from the temporo-facial division.

has three sets of branches.

Temporal branches pass to side of head.

The *temporal branches* ascend obliquely over the zygoma to the orbicular muscle and anterior part of the occipito-frontalis, in which they are united with offsets of the supra-orbital nerve. The attrahens aurem muscle is supplied by this set; and a junction takes place above the zygoma with the temporal branch of the superior maxillary nerve.

Malar branches go to eyelids.

The *malar branches* are directed to the outer angle of the orbit where they are distributed to the orbicular muscle and the eyelids. In the

eyelids communications occur with the palpebral filaments of the fifth nerve (p. 33.); and near the outer part of the orbit with the small subcutaneous malar branch of the superior maxillary nerve.

The *infra-orbital branches* are larger than the rest, and are furnished to the muscles and integument between the eye and mouth. Close to the orbit, and beneath the elevator of the upper lip, a remarkable communication is found between these nerves and the infra-orbital branches of the superior maxillary. After crossing the branches of the fifth nerve, some small offsets of the facial nerve pass inwards to the side of the nose, and others upwards to the inner angle of the eye, to join the nasal and infra-trochlear branches of the ophthalmic nerve. Infra-orbital branches are lost between eye and mouth.

B. The CERVICO-FACIAL DIVISION of the portio dura is smaller than the other trunk, and supplies branches to the lower part of the face and to the upper part of the neck. Its highest branches join the lowest offsets of the temporo-facial division, and thus complete the network on the face. This trunk, whilst in the parotid, gives twigs to the gland, and is united with the great auricular nerve. The branches of distribution are buccal, supra-maxillary, and infra-maxillary. Lower division also gives three sets of branches.

The *buccal branches* pass forwards to the angle of the mouth, where they terminate in the orbicular muscle. On the buccinator they join the branch of the inferior maxillary nerve to that muscle. Buccal branches to corner of mouth.

The *supra-maxillary branches* course inwards above the base of the lower jaw to the middle line of the chin, and supply the muscles and integument between the chin and mouth. Beneath the depressor anguli oris the branches of the facial join offsets of the labial branch of the inferior dental nerve, in the same manner as the union is made below the orbit, viz. the branches of the facial cross those of the fifth nerve in their course onward to the middle line. Supra-maxillary between mouth and chin.

The *infra-maxillary branches* are placed below the jaw, and are distributed to the upper part of the neck. The anatomy of these nerves is given with the dissection of the anterior triangle of the neck. Infra-maxillary branches.

SECTION IV.

THE ORBIT.

IN the examination of the orbit, the head is placed in the same position as in the dissection of the sinuses of the base of the skull. Position of the body.

Dissection.—To open the orbit, raise the roof in the following Dissection.

manner:—through the margin of the orbit make two cuts with a saw, one being placed at the outer angle, the other at the inner angle of the cavity. With a chisel extend backwards these cuts along the roof of the orbit, nearly to the optic foramen. The piece of bone included in the incisions may now be tilted forwards, but is not to be cut away. Afterwards, with the bone forceps, remove all the rest of the roof of the orbit, except the ring of bone that surrounds the optic foramen, and take away any over-hanging bone on the outer side that may interfere with the dissection. The dissector should take care that all the wadding is removed from the eyelids, and the eye pulled gently forwards. The periosteum is now exposed.

Periosteum of orbit.

The *periosteum* of the orbit is a prolongation of the dura mater of the brain through the sphenoidal fissure. It incases the contents of the orbit like a sac, and adheres but loosely to the bones. Apertures exist posteriorly in the membrane for the entrance of the different nerves and vessels, and on the sides prolongations of the membrane accompany the vessels and nerves that leave the cavity.

Apertures in it.

Dissection.

Dissection.—Divide the periosteum along the middle of the orbit, and take it away. After the removal of a little fat, the following nerves, vessels, and muscles come into view:—the frontal nerve and vessels lie in the centre, the lachrymal nerve and vessels close to the outer wall of the cavity, and the small fourth nerve at the back of the orbit. These nerves enter the orbit above the muscles. The frontal and lachrymal should be followed forwards to their exit from the orbit, and all of them backwards through the sphenoidal fissure to the wall of the cavernous sinus. In tracing back the nerves, it will be expedient to remove the projecting clinoid process, if this still remains; and some care and trouble will be necessary in order to follow the lachrymal nerve to its commencement. The superior oblique muscle is recognised by the fourth nerve entering it: the levator palpebræ and superior rectus are beneath the frontal nerve; and the external rectus is partly seen below the lachrymal nerve. In the outer part of the orbit, near its front, is the lachrymal gland. The muscles, vessels, and nerves referred to above are to be cleaned and examined, but it is not requisite to take all the fat from the orbit in this stage of the dissection.

In the orbit is eyeball,

Contents of the orbit.—Besides the eyeball and lachrymal gland, there is a great quantity of granular fat in the orbit.

Connected with the eye are six muscles — four straight and two oblique; and there is also in the cavity an elevator of the upper eyelid. The nerves in this small space are numerous, viz. the second, third, fourth, ophthalmic (of the fifth), and sixth nerve, and their general distribution is as follows: — the second nerve enters the eyeball, the third is furnished to all the muscles but two, the fourth enters the superior oblique (one of the two excepted), and the sixth is spent in the external rectus muscle. The fifth nerve supplies some filaments to the eyeball, but the greater number of its branches pass through the orbital cavity to the face. The ophthalmic vessels are likewise contained in the orbit.

with seven muscles, several cranial nerves, and vessels.

The *lachrymal gland* secretes the tears, and is situate in the hollow on the inner side of the external angular process of the frontal bone. It is of a lengthened form, something like an almond; and from its anterior part a thin piece projects towards the upper eyelid. The upper surface is convex, and in contact with the periosteum, to which it is connected by fibrous bands (ligament of the gland); the lower surface rests on the eye and the external rectus muscle.

Lachrymal gland is at the outer part of orbit.

In *structure*, the lachrymal resembles the salivary glands; and its ducts, from about six to twelve in number, open by as many apertures in a semicircular line on the inner surface of the upper eyelid, near the outer canthus.

Its ducts open on upper eyelid.

The FOURTH NERVE is the most internal in position of the three nerves that enter the orbit above the muscles. After reaching this space, it is directed inwards to the superior oblique muscle, which it enters at the external surface, contrary to the general distribution of the nerves on the ocular surface of the muscles.

Fourth nerve supplies superior oblique.

The OPHTHALMIC NERVE (of the fifth) as it approaches the sphenoidal fissure, furnishes from its inner side the nasal branch, and then terminates by dividing into the frontal and lachrymal branches; the former enters the orbit between the heads of the external rectus, but the other two are above the muscles.

Ophthalmic nerve gives three branches.

1. The *frontal nerve* is close to the outer side of the fourth as it enters the orbit, and is much larger than the lachrymal branch. In its course to the forehead the nerve lies along the middle of

Frontal branch supplies

the following. the orbit, and bifurcates anteriorly into the supra-trochlear and supra-orbital branches.

Branch above the pulley of oblique muscle; sometimes two

a. The *supra-trochlear branch*, which is of small size, passes inwards towards the pulley of the superior oblique muscle, where it leaves the orbit to end in the eyelid and forehead (p. 6.). Before the nerve turns round the margin of the frontal bone, it sends downwards a branch of communication to the infra-trochlear branch of the nasal nerve. Frequently there are two supra-trochlear branches; in such instances one branch arises near the back of the orbit.

and branch through orbital notch.

b. The *supra-orbital branch* is the continuation of the frontal nerve in direction and size, and passes from the orbit by the supra-orbital notch. It then turns upward on the forehead, and supplies the external part of the head (p. 6.). Whilst in the notch the nerve gives downwards palpebral filaments to the upper lid.

Lachrymal nerve ends in eyelid;

2. The *lachrymal nerve*, after entering the orbit in a separate tube of dura mater, is directed forwards in the outer part of the cavity, and beneath the lachrymal gland, to the upper eyelid, where it pierces the palpebral ligament, and is distributed to the structures of the lid.

its offsets join superior maxillary.

The nerve furnishes branches to the lachrymal gland, and near the gland it sends downwards one or two small filaments to communicate with the orbital branch of the superior maxillary nerve. Occasionally this nerve takes origin from the fourth as well as the ophthalmic nerve.

3. The *nasal nerve* is not visible at this stage of the dissection: it will be noticed afterwards at p. 42.

Dissection.

Dissection. — Divide the frontal nerve about its middle, and throw the ends forwards and backwards. In raising the posterior part of the nerve, the distinct origin of the nasal branch from the ophthalmic trunk will be seen. The lachrymal nerve may remain uncut.

Elevator of upper eyelid is attached to tarsal cartilage; is highest muscle in orbit.

The LEVATOR PALPEBRÆ SUPERIORIS is the most superficial muscle, and is *attached* posteriorly to the roof of the orbit in front of the optic foramen. The muscle widens as it extends forwards, and in front of the eyeball it turns downwards, and is *inserted* by a wide tendon into the upper part of the tarsal cartilage. By one surface the muscle is in contact with the frontal nerve and the periosteum, and by the other with the superior rectus muscle. If it is cut across about the centre, a small branch of nerve (from the third) will be seen entering the under-surface.

The RECTUS SUPERIOR is the upper of the four muscles that lie around the globe of the eye. It *arises* from the upper part of the optic foramen, and is connected with the other recti muscles around the optic nerve. Near the front of the eye the fleshy fibres end in a tendon, which is *inserted* into the sclerotic coat rather behind the point of union between it and the cornea. The lower surface of the muscle is in contact with the globe of the eye, and the vessels and nerves to be afterwards seen: the other surface is covered by the preceding muscle.

Upper rectus muscle. Origin. Insertion. Position to other parts.

The SUPERIOR OBLIQUE MUSCLE is thin and narrow, and passes through a pulley at the inner angle of the orbit. The muscle *arises* from the inner part of the optic foramen, and ends anteriorly in a tendon, which, after passing through the pulley, is reflected between the superior rectus and the globe of the eye, and is *inserted* into the sclerotic coat rather behind the middle of the eyeball. The fourth nerve is supplied to the orbital surface of the muscle, and the nasal nerve lies below it. The insertion of the muscle is between the superior and the external rectus, and close to the tendon of the inferior oblique.

Upper oblique muscle enters a pulley. Insertion. Connections.

The *pulley*, or *trochlea*, is a fibro-cartilaginous ring, which is attached to the depression of the frontal bone at the inner angle of the orbit. A synovial membrane lines the ring, and facilitates the movement of the tendon through it. From the margins of the pulley there is a fibrous prolongation on the tendon. To see the synovial membrane the prolongation must be taken away.

Pulley of the muscle.

Dissection. — Cut across the superior rectus muscle about the middle, and turn it backwards, seeking at the same time a branch of the third nerve to its under-surface. The nasal nerve and the ophthalmic artery and vein will be found crossing inwards above the optic nerve: these should be traced to the inner angle and to the posterior part of the orbit. By taking away some of the fat between the optic nerve and the external rectus at the back of the orbit, the small lenticular ganglion and its branches will be discovered: the student will find the ciliary branches that lie along the side of the optic nerve the best guide to the ganglion. The dissector should then find the branches to the ganglion from the nasal and third nerves. And, lastly, he should separate from one another the nasal,

Dissection. Of lenticular ganglion.

third, and sixth nerves, as they enter the orbit between the heads of the external rectus muscle.

Third nerve as it enters orbit. The THIRD NERVE is highest in position in the wall of the cavernous sinus, but at the sphenoidal fissure it descends below the fourth, and the two branches (frontal and lachrymal) of the ophthalmic nerve. The nerve enters the orbit between the heads of the outer rectus, having previously divided into two parts.

Its upper branch. *a.* The *upper division*, the smallest in size, ends in the under surfaces of the levator palpebræ and the superior rectus muscle.

Lower branch. *b.* The *lower division* supplies some of the other muscles, and will be dissected afterwards.

Nasal nerve. The *nasal branch* of the ophthalmic nerve enters the orbit between the heads of the rectus, and lies between the divisions of the third nerve. In the orbit the nerve is directed obliquely inwards, to reach the anterior of the two General course to the face. foramina in the inner wall. Passing through this aperture, the nerve appears in the cranium, at the outer margin of the cribriform plate of the ethmoid bone. Finally, it enters the nasal cavity by an aperture in the front of the cribriform plate, and ends on the outer side of the nose, after passing between the nasal bone and cartilage.

Position in orbit. In the orbit, the nasal lies, at first, over the optic nerve, and beneath the superior rectus and levator palpebræ muscles, and afterwards below the superior oblique; in this part of its Branches. course it furnishes the following *branches*:—

Long root of lenticular ganglion. *a.* The *branch to the lenticular ganglion* is about half an inch long and very slender, and arises as soon as the nerve enters the orbit. This is the long root of the lenticular ganglion.

Long ciliary branches. *b. Long ciliary branches.*—As the nasal crosses the optic nerve, it supplies two or more ciliary branches to the eyeball. These lie on the inner side of the optic, and join the short ciliary branches of the lenticular ganglion.

Infra-trochlear branch. *c.* The *infra-trochlear branch* arises as the nasal nerve leaves the orbit, and is directed forwards below the pulley of the superior oblique muscle to the inner part of the orbit, where it ends in the upper eyelid, conjunctiva, and side of the nose. Before this branch leaves the orbit it receives an offset of communication from the supra-trochlear nerve.

Termination of the nasal nerve.—After the nerve becomes cutaneous on the side of the nose, it descends beneath the compressor naris muscle, and ends in the integuments of the ala and tip of the nose. Ending of nasal nerve.

The OPHTHALMIC OR LENTICULAR GANGLION is a small roundish body, of the size of a pin's head, and of a reddish colour. It is placed at the back of the orbit, between the optic nerve and the external rectus, and commonly on the outer side of the ophthalmic artery. By its posterior part the ganglion has branches of communication with other nerves (its roots), and from the anterior part proceed the ciliary nerves to the eyeball. In the ganglion are combined sensory, motory, and sympathetic filaments. Lenticular ganglion. Situation. Connection. Structure.

The *branches of communication* are three in number. One, the *long root*, is the branch of the nasal nerve before noticed, which joins the superior angle. A second branch of considerable thickness (*short root*) passes from the inferior angle to join the branch of the third nerve to the inferior oblique muscle. And the third *root* is derived from the sympathetic (its cavernous plexus), either as a distinct branch to the posterior border of the ganglion, or in union with the long root. Three roots: long, short, and sympathetic.

Branches of distribution.—The short *ciliary nerves* are ten or twelve in number, and are collected into two bundles, which leave the upper and lower part (superior and inferior angle) of the ganglion. In the upper bundle are four or five, and in the lower, six or seven nerves. As they extend along the optic nerve to the eyeball they occupy its outer and under part, and communicate with the long ciliary branches of the nasal nerve. Ciliary branches to eyeball.

The OPHTHALMIC ARTERY is a branch of the internal carotid, and enters the orbit through the optic foramen. At first the vessel is outside the nerve, but it then courses inwards, over the nerve, to the inner angle of the orbit, where it ends in terminal branches. Ophthalmic artery in orbit.

The *branches* of the artery are numerous, though inconsiderable in size, and they are sometimes arranged in three sets; one outside the optic nerve, another above it, and a third set internal to the same. Branches.

a. The *lachrymal branch* accompanies the nerve of the same name to the upper eyelid, where it ends by supplying that part, and anastomosing with the palpebral arches. It supplies branches, like the nerve, to the lachrymal gland and to the conjunctiva; it anastomoses also Lachrymal branch supplies gland.

with the middle meningeal and deep temporal arteries, by offsets through the sphenoidal fissure and outer wall of the orbit.

Branch of the retina. *b.* The *central artery of the retina* is a very small branch that enters the optic nerve, and so reaches its destination in the eyeball.

Supra-orbital branch. *c.* The *supra-orbital branch* arises beneath the levator palpebræ and superior rectus muscles: it then takes the course of the nerve of the same name through the notch in the margin of the orbit, and ends in branches on the forehead (p. 5.). As it turns round the margin of the orbit it supplies the eyelid and the orbicularis muscle.

Ciliary arteries are posterior; *d.* The *ciliary branches* are uncertain in their origin, and enter the eyeball either at the front or back. The *posterior ciliary* are furnished from the ophthalmic, or some of its branches. About twelve in number, they are continued to the eyeball around the optic nerve, and perforate the sclerotic coat at its posterior part. In the eye these arteries extend forwards between the sclerotic and choroid coats to the iris. Two of this set (one on each side of the optic nerve) are named long ciliary; they pierce the sclerotic coat further out than the rest, and are then placed along the middle of the eyeball. The *anterior ciliary* arteries arise from the muscular branches, and pierce the sclerotic coat near the cornea. In the eyeball they anastomose with the posterior ciliary.

two named long ciliary; and anterior ciliary.

Muscular. *e.* The *muscular branches* are furnished from the artery in its course, and those to the lower muscles often arise together.

Ethmoidal branches. Posterior and anterior. *f.* The *ethmoidal branches* are two, anterior and posterior, which pass through the two foramina in the inner wall of the orbit. The *posterior* is the smaller of the two, and furnishes small meningeal arteries to the dura mater of the base of the skull. The *anterior* accompanies the nasal nerve, and gives small meningeal offsets to the dura mater. Both send branches to the nose through the apertures in the cribriform plate.

Branches to eyelids. *g.* The *palpebral branches*, one for each eyelid, generally arise together opposite the pulley of the superior oblique muscle, and then separate from one another. The arches they form have been dissected with the eyelids (p. 32.).

h. The *nasal branch* is one of the last branches of the ophthalmic, and is distributed to the side of the nose, on which it anastomoses with the nasal and angular branches of the facial artery.

i. The *frontal branch* turns round the margin of the orbit, and is distributed on the forehead (p. 5.).

Ophthalmic vein. The *ophthalmic vein* corresponds in its course and branches to the artery of the same name. It begins at the inner angle of the orbit, where it joins the facial vein, and receives tributary branches in its progress to the back of that cavity. Posteriorly, it leaves the artery, and escapes from

the orbit by the sphenoidal fissure, between the heads of the external rectus. It ends in the cavernous sinus. ends in cavernous sinus.

The OPTIC NERVE is now seen to extend from the optic foramen to the back of the eyeball. As the nerve enters the foramen, it is surrounded by the recti muscles; and beyond that spot, as far as the eyeball, the ciliary arteries and nerves entwine around it. It terminates in the retina. Optic nerve ends in retina.

Dissection. — Take away the ophthalmic artery, and divide the optic nerve about its middle, together with the small ciliary vessels and nerves. Turn forwards the eyeball, and fasten it in that position with hooks. On removing some fat, the three recti muscles (inner, outer, and inferior), and the lower division of the third nerve will appear. Dissection.

The *lower division of the third nerve*, in entering the orbit, lies below the nasal, and rather above the sixth nerve. Almost immediately afterwards the nerve divides into three large branches. One of these enters the internal rectus, another the inferior rectus; and the third, the longest and most external branch, is continued forwards to the inferior oblique muscle. Soon after its origin, the last nerve communicates with the lenticular ganglion (short root), and furnishes two or more filaments to the inferior rectus. Lower branch of third nerve is muscular, and joins lenticular ganglion.

The SIXTH NERVE enters the orbit between the heads of the external rectus, and above the ophthalmic vein. In the orbit it turns outwards to the ocular surface of the external rectus muscle, to which it is distributed. Sixth nerve enters external rectus.

RECTI MUSCLES. — The *internal, inferior*, and *external rectus* muscles are placed, as their names express, with reference to the eyeball. They *arise* posteriorly by a common attachment around the optic nerve; and the external rectus has, moreover, an additional fasciculus of origin, which is united with the superior rectus. The muscles are directed forwards, and have a tendinous *insertion* into the ball of the eye, near the cornea. From the margins of the tendons an aponeurotic expansion is derived, which forms a partial covering for the globe of the eye (*tunica albuginea*). Beneath each tendon, near its insertion, is situate a small bursa. Between the heads of origin of the external rectus, the dif- Straight muscles of eyeball. Origin. Insertion and peculiarity of the tendons.

ferent nerves before mentioned enter the orbit, viz. the third, the nasal branch of the fifth, and the sixth.

Dissection. *Dissection.*—By opening the optic foramen, the attachment of the recti muscles will be more fully seen. To dissect out the inferior oblique muscle, replace the eyeball in its natural position, take away the conjunctiva of the lower eyelid near the inner part, and remove the fat that conceals the muscle.

Lower oblique muscle. The INFERIOR OBLIQUE MUSCLE is situate near the anterior margin of the orbit, and differs from the other muscles in the fact of its being directed across, instead of in the axis of the orbit. Origin. It *arises* from the superior maxillary bone, just within the margin of the orbit, and near the groove for the lachrymal sac. Course. From this spot the muscle passes outwards beneath the inferior rectus, and then between the eyeball and external rectus, to be *inserted* into the sclerotic coat, between the last muscle and the superior rectus. Insertion. The borders of the muscle look forwards and backwards, and the posterior receives the branch of the third nerve. Connections. The tendon of insertion is close to that of the superior oblique muscle, but nearer the optic nerve.

Dissection. *Dissection.*—To expose the small tensor tarsi muscle, separate the eyelids from the margin of the orbit, where this has not been done, and leave them attached at the inner angle by means of the tendo palpebrarum. By looking to the posterior aspect of the tendon, after the fibres of the orbicularis have been removed from it, the pale fibres of the tensor tarsi will be seen.

Tensor tarsi muscle. The TENSOR TARSI MUSCLE *arises* from the ridge on the os unguis, and slightly from the bone behind the ridge. Its fibres are pale, and form a very small flat band, behind the tendo palpebrarum, which divides like that tendon into a slip for each eyelid. Insertion. Each slip is *attached* to the inner part of the tarsal cartilage.

Dissection. *Dissection.*—A small nerve, the orbital branch of the superior maxillary nerve, lies in the outer angle of the floor of the orbit, and will come into view by the removal of the eyeball and its muscles. This nerve is very soft and is easily broken. Two branches, temporal and malar, are to be traced forwards from it, and a filament of the lachrymal nerve is to be followed to its junction with the former. The outer wall of the orbit may be cut

away, bit by bit, to follow the temporal branch through to the surface of the head.

The *orbital branch* of the *superior maxillary nerve* arises in the spheno-maxillary fossa, and enters the orbit by the fissure of the same name. At the back of the orbit the nerve divides into malar and temporal branches, which ramify in the face and the side of the head. Orbital branch of superior maxillary nerve;

a. The *malar branch* (r. subcutaneus malæ) is directed forwards along the floor of the orbit, and through a foramen in the malar bone to the face. After emerging from its foramen, this branch supplies the orbicularis, and communicates with the facial nerve. its malar

b. The *temporal branch* ascends on the outer wall of the orbit, either beneath the periosteum, or in a groove in the bone, and being joined by a filament from the lachrymal nerve, passes into the temporal fossa through a foramen in the malar bone. The nerve then turns upwards between the temporal muscle and the bone, and perforates the temporal fascia near the orbit. Its distribution was seen in the examination of the cutaneous nerves of the head (p. 6.). and temporal branches.

LACHRYMAL APPARATUS. — The lachrymal gland and ducts, with the puncta, canals, and sac, constitute the apparatus by which the tears are formed and conveyed to the nose. The gland has been already described (see p. 39.). Apparatus of the tears.

Dissection. — Some bristles should be introduced into the lachrymal canals through the puncta of the eyelids that remain attached. The lachrymal sac will appear by removing the tensor tarsi and the cellular membrane from its surface, as it lies on the os unguis. The prolongation from the tendo palpebrarum over the sac should likewise be prepared. Dissection.

The *puncta lachrymalia* are two small apertures, one for each lid, by which the tears enter the lachrymal canals. Each is placed about two lines from the inner canthus, and in an elevation (papilla lachrymalis) in the free margin of the lid. Apertures in eyelids.

The *lachrymal canals* are two small tubes that reach from the puncta, and convey the tears to the lachrymal sac; their situation is marked by the bristles that are inserted in them. In their course inwards, the canals lie along the tendo palpebrarum, one above and the other below it, and they are somewhat arched with the concavity towards the tendon. Internally, they open near together into the Canals for the tears.

Difference in the two lids. lachrymal sac, rather above its middle. The canal in the upper eyelid is longer and more arched than that in the lower lid.

Receptacle of the tears. The *lachrymal sac* and *duct* extend from the inner part of the orbit to the nose, and convey the tears into the latter cavity. They form one tube, of which the upper dilated part is the sac, and the lower constricted end the duct.

Situation of the sac, or dilated part. The *sac* is situate in the hollow of the os unguis and nasal process of the superior maxillary bone. Externally, it is crossed by the tendo palpebrarum, and is covered by an expansion derived from that tendon, which is fixed to the margins of the bony groove. If the aponeurotic covering is removed, the mucous membrane will be seen lining the interior. Into the outer side of the sac the lachrymal canals open.

Canal leading to the nose. The *duct* (ductus ad nasum) is the narrow part of the tube that reaches to the inferior meatus of the nose, into the anterior part of which it opens. It is entirely encased by bone, and its length, size, and direction are the same as in the dried skull. A bent probe will pass readily into the duct from the meatus.

Anatomy of eyeball afterwards. The examination of the eyeball must be made on the fresh eye of either the ox or sheep, and this may be omitted with advantage to the student till after the dissection of the head and neck is completed.

Section V.

THE NECK.

Position of the part. *Position.*—In this dissection let the head be supported at a moderate height. Turn, then, the face to the left side, and fasten it in that position with hooks; next let the right arm be placed under the body, so that the point of the shoulder may be depressed. By these means the parts will be put on the stretch, and a good view obtained of the right side of the neck.

Boundaries of the side of neck. *Surface marking.*—The side of the neck presents a somewhat square outline, and is limited by the following parts:—

inferiorly is the prominence of the clavicle, and superiorly is the base of the lower jaw and the skull. In front, the limit is marked by a line from the chin to the sternum, and behind by another line from the occiput to the acromial end of the clavicle. The part thus marked out is divided into two triangular spaces by the diagonal position of the sterno-mastoid muscle. From the direction of that muscle the base of the anterior space is at the jaw, and the apex at the sternum, whilst the base of the posterior one is at the clavicle, and the apex at the head. The surface in front of the sterno-mastoid is depressed at the upper part of the neck, over the position of the carotid vessels; and behind the muscle is another slight hollow, near the clavicle, which points to the situation of the subclavian artery.

Division into two triangles by sterno mastoid.

Along the middle line of the neck the following parts will be recognised through the skin: — about two inches and a half from the base of the jaw is the eminence of the os hyoides, with its cornu extending laterally. Below this will be felt the wide prominence of the thyroid cartilage (pomum Adami), which is most marked in man; and between the cartilage and the hyoid bone is a slight interval, corresponding to the thyro-hyoid membrane. Inferior to the thyroid is the narrow prominent ring of the cricoid cartilage, and between the two the finger will distinguish another hollow, which is opposite the crico-thyroid membrane. From this spot to the sternum there is a depression between the sterno-mastoid muscles, in which the tube of the trachea can be felt; the depth of this depression is much increased in emaciated individuals. In some bodies, especially in women, the swelling of the thyroid gland can be perceived by the side of the upper part of the trachea.

Prominences in the middle line of neck,

and supra-sternal depression.

Dissection.—It will be more advantageous for the student to examine one triangular space at a time, than to lay bare at once the whole side of the neck. To expose the posterior triangle, and the structures that cross this part of the neck, divide the skin along the sterno-mastoid from one end to the other, and make a second incision along the clavicle to the acromion. Reflect the flap of skin towards the posterior part, or the trapezius muscle. The superficial fascia, which will be then brought into view, con-

Dissection of the posterior triangle.

tains the platysma. To see that muscle, it will be necessary to take the subcutaneous layer from its surface.

Platysma muscle

The PLATYSMA MYOIDES is a thin muscular layer, which is now seen only in its lower half. The muscle is placed across the side of the neck, and extends from the top of the shoulder to the base of the lower jaw. The fibres take *origin* from the superficial fascia over the upper part of the pectoral and deltoid muscles, and then ascend over the clavicle and the triangular spaces of the neck, to be *inserted* into the jaw. The lower part of the muscle is more closely united to the skin than the upper, and covers the posterior triangle in part, also the external jugular vein. At first the fibres of the muscle are thin and scattered, but they increase in strength as they ascend.

arises at shoulder; inserted into jaw; covers triangle.

Dissection.

Dissection.—Raise with care the platysma as far as the border of the sterno-mastoid muscle, without destroying the deep fascia of the neck, the external jugular vein, or the superficial descending branches of the cervical plexus, which are close beneath the platysma. The dissector should note the direction of the fibres of the platysma, because in venesection of the external jugular vein the incision is so made as to cut them across.

External jugular vein

The *external jugular vein*, commencing in the parotid gland (p. 28.), is directed backwards between the platysma and deep fascia to the lower part of the neck, where it pierces the fascia to open into the subclavian vein. In its course down the neck it is joined by small superficial branches, and sometimes an offset connects it with the anterior jugular vein. Its size, and the height at which it crosses the sterno-mastoid muscle, may be very uncertain.

crosses side of neck to subclavian.

Cervical fascia.

The *deep cervical fascia* consists, like the aponeuroses of other parts, of a superficial layer that surrounds continuously the part invested, and of processes that are prolonged inwards between the muscles. In some bodies this fascia is thin and indistinct. In its extent round the neck the membrane incases the sterno-mastoideus, and presents a different disposition before and behind that muscle. Passing backwards from the muscle, the fascia is continued over the posterior triangular space, and then to the border of the trapezius, which it encloses in its progress to the spines of the vertebræ.

Part behind sterno-mastoid muscle

At the lower part of the neck the fascia is attached to the clavicle, and is perforated by the external jugular vein and the cutaneous nerves. If the superficial layer is removed near the clavicle, a deep process may be observed to envelop the small omo-hyoid muscle, and to extend beneath the clavicle to the costo-coracoid sheath of the axillary vessels. sends a process beneath clavicle.

Dissection.—By the removal of the cervical fascia and the fat from the space between the sterno-mastoid and trapezius muscles, the posterior triangle of the neck will come into view. Above the omo-hyoid muscle, whose position is about an inch from the clavicle, will be found the ramifications of the branches of the cervical plexus and the spinal accessory nerve. The latter is recognised by its piercing the sterno-mastoid muscle. The greater number of the branches of the cervical plexus descend to the shoulder, but the small occipital and great auricular nerves ascend to the head, whilst the superficial cervical branch turns forwards over the sterno-mastoid muscle. Below the omo-hyoideus are the subclavian artery and brachial plexus, which have a deep position. Seek the supra-scapular vessels behind the clavicle; the transverse cervical vessels beneath the omo-hyoid muscle; and, lastly, the branch of nerve to the subclavian muscle, which lies about the middle of the space between the clavicle and that muscle. Dissection. of nerves and vessels in triangular space.

The POSTERIOR TRIANGULAR SPACE OF THE NECK is bounded in front by the sterno-mastoid muscle, and behind by the trapezius. Its base corresponds to the middle third of the clavicle, and its apex is at the skull. Covering the space, are found the structures already examined, viz. the skin and superficial fascia, the platysma in the lower third, and the deep fascia. The small omo-hyoid muscle crosses the lower part of the space, so as to subdivide it into a lower or clavicular, and an upper or occipital part. Posterior triangular space of the neck is divided into two by omohyoideus.

The *clavicular part* is of small size, and is close to the clavicle; in it is the subclavian artery. This small space measures commonly about one inch and a-half from before backwards, but somewhat less from above downwards. It is bounded in front by the sterno-mastoid, above by the omo-hyoid muscle, and below by the clavicle. Part near clavicle.

Crossing the area of the space, rather above the level of the clavicle, is the trunk of the subclavian artery (its third Vessels and nerves

in this part, part), which issues from beneath the anterior scalenus muscle, and is directed over the first rib to the axilla. Above the artery are the large cords of the brachial plexus, which accompany the vessel, and become closely applied to it beneath the clavicle. Beneath the artery and the nerves is the posterior scalenus muscle. Along the clavicular side of the space, and somewhat beneath the clavicle, are the supra-scapular vessels; and crossing the upper part, at the meeting of the omo-hyoid and sterno-mastoid muscles, are the transverse cervical vessels. Entering the space from above is the external jugular vein, which descends over the omo-hyoideus near its anterior part, and opens into the subclavian vein; in this spot the vein receives the supra-scapular and transverse cervical branches, and sometimes a small vein, over the clavicle, from the cephalic vein of the arm.

and their relative position.

Variations in the size of the space; The size of the clavicular part of the posterior triangular space is influenced by the extent of attachment of the trapezius and sterno-mastoid muscles along the clavicle, since in some bodies these muscles occupy nearly the whole length of the bone. Again; the space may be increased or diminished by the position of the omo-hyoideus in the neck; for this muscle may lie close to the clavicle, being attached thereto, or it may be distant one inch and a half from that bone. In depth the space varies naturally, and in a short thick neck, with a prominent clavicle, the artery is farther from the surface than in the opposite condition of the parts. But the depth is altered much more by the position of the arm to the body, according as the limb is raised or depressed; for the arm and shoulder may be carried upwards until the clavicle rises above the level of the omo-hyoid muscle, and entirely conceals the artery in its usual position.

also in the depth, both natural and artificial.

Departure from the ordinary state of the vessels. *Peculiarities in the vessels.*—The situation of the trunk of the subclavian artery, just above the prominence of the clavicle, may vary so much as to be placed one inch and a half higher in the neck, or at any point intermediate between the two extremes. Further, its position to the anterior scalenus may be altered, for instead of the subclavian being beneath, it may be in front of, or even between the fibres of that muscle. Commonly there is not any branch on the artery in this part of its course; but the posterior scapular branch may take origin from it at different distances from the scalenus, or there may be more

than one branch. In the ordinary disposition of the vessels the subclavian vein is not seen, owing to its situation being lower down, beneath the clavicle, but it may rise upwards so as to touch the artery, or even lie with the artery beneath the anterior scalenus in rare instances. The position of the external jugular vein with regard to the subclavian artery is very uncertain, and the branches connected with its lower part may form a kind of plexus over the arterial trunk.

The *occipital part* of the posterior triangular space is of larger extent than the other. Its boundaries in front and behind are the same as in the clavicular part, and it is separated from that space by the omo-hyoid muscle. In it are contained chiefly the ramifications of the cervical plexus, and a chain of lymphatic glands lies along the sterno-mastoid muscle. Beneath the spinal nerves is the posterior scalenus, and still farther behind are some of the muscles of the back. The spinal accessory nerve is directed obliquely across this interval from the sterno-mastoid muscle, which it pierces, to the under-surface of the trapezius; and a communication takes place between this cranial nerve and the spinal nerves in the triangular space.

Part of triangular space near the head contains cervical plexus and lymphatic glands; also spinal accessory nerve.

SUPERFICIAL BRANCHES OF THE CERVICAL PLEXUS. — Behind the sterno-mastoid muscle appear some of the ramifications of the cervical nerves in the plexus of the same name, and from them superficial branches are furnished both upwards and downwards.

Nerves of the cervical plexus

A. The ASCENDING SET are three in number, viz. small occipital, great auricular, and superficial cervical.

that ascend are

1. The *small occipital branch* comes from the second cervical nerve, and is directed upwards to the head along the posterior border of the sterno-mastoid muscle. At first the nerve is beneath the fascia, but near the occiput it becomes cutaneous, and is distributed between the ear and the great occipital nerve (see p. 8.). Occasionally there is a second nerve to the head.

small occipital,

2. The *great auricular nerve* is a branch of that part of the plexus which is formed by the second and third nerves. Perforating the deep fascia at the posterior border of the sterno-mastoid muscle, the nerve is then directed upwards beneath the platysma to the lobule of the ear, where it ends in the following branches: —

great auricular.

a. The *facial branches* are sent forwards to the integument over the

Supplies facial,

parotid, and a few slender filaments pass through the gland to join the facial nerve.

auricular, *b.* The *auricular branches* ascend to the external ear, and are chiefly distributed on its cranial aspect; one or more reach the opposite surface by piercing the pinna. On the ear they communicate with the branches furnished from the facial and pneumogastric nerves.

and mastoid branches. *c.* The *mastoid branch* is directed backwards to the integument between the ear and mastoid process; it joins the posterior auricular branch of the facial nerve.

Superficial cervical nerve. 3. The *superficial cervical nerve* springs from the same source as the preceding, and turns forwards round the sterno-mastoid muscle about its middle. Afterwards it pierces the fascia, and ramifies over the anterior triangular space, beneath the platysma myoides (see p. 55.). There may be more than one branch to represent this nerve.

Nerves that descend are B. The DESCENDING SET of branches (supra-clavicular) are derived from the third and fourth nerves of the plexus, and are directed towards the clavicle over the lower part of the posterior triangular space. Their number is somewhat uncertain, but usually there are about three.

sternal, supra-clavicular, and acromial. The most internal branch (sternal) crosses the clavicle near its inner end; the middle branch lies about the middle of the clavicle; and the posterior (acromial) turns over the attachment of the trapezius to the acromion. All are distributed to the integuments of the chest and shoulder.

Lymphatic glands of neck. The *lymphatic glands* (glandulæ concatenatæ) that lie along the sterno-mastoid muscle, are continuous at the lower part of the neck with the glands in the cavity of the thorax. There is also a superficial chain along the external jugular vein.

Dissection. *Dissection.*—Repeat the dissection of the posterior triangle on the left side of the neck. Afterwards replace the reflected parts, and carefully fasten them in their natural position with a few stitches, after some preservative fluid has been applied by means of strips of calico.

Dissection of back made now. The posterior part of the neck may be most advantageously examined at this stage with the dissection of the back. After the completion of the muscles, vessels, and nerves of the back, the student will dissect the spinal cord, and then return to the examination of the front of the neck.

Position.—When the body is turned again for the dissection of the remainder of the right side of the neck, the position should be the same as that for the dissection of the posterior triangular space. If the thorax is finished, the head and neck may be taken from the trunk by dividing the spinal column between the second and third dorsal vertebræ. By this step the dissector obtains the clavicles and the first ribs, and preserves the natural position of the parts at the root of the neck: he should moreover be careful to take the arch of the aorta. After the part is detached, place a small narrow block beneath the neck, and make it tense with hooks, in the position mentioned above.

Position of body to examine right side of neck.

Directions to be observed by the student.

Dissection.—Raise the piece of integument in front of the sterno-mastoideus towards the middle line. The incision along the base of the jaw readily allows of this proceeding. Beneath the skin is the superficial fascia, containing the ramifications of the superficial cervical nerve. Dissect out the nerve by following forwards the trunk, and then take away the fat to expose the anterior part of the platysma muscle.

Dissection.

Platysma Myoides.—The anterior part of the platysma extends from the sterno-mastoid muscle to the lower jaw, covering part of the anterior triangular space in the same manner as it concealed the posterior. The fibres have the same appearance in the upper as in the lower half of the muscle, but they are rather stronger. At the base of the jaw they end in the following manner: — the most internal fibres are blended with the muscle of the opposite side; the most external are inserted into the oblique line on the side of the jaw; and the intervening fibres mingle with the depressor anguli and depressor labii inferioris muscles. This part of the muscle is superficial, and covers the upper part of the anterior triangular space.

Platysma muscle in front of sterno-mastoid.

Insertion into jaw.

Covers anterior triangle.

The *superficial cervical nerve* has been traced from its origin in the cervical plexus to its position superficial to the fascia of the neck (p. 54.). Beneath the platysma the nerve divides into an ascending and a descending branch. The nerve may arise from the plexus by two pieces.

Superficial cervical nerve.

The *ascending branch* perforates the platysma, and is distributed to the integuments over the anterior triangle, about half way down the

Branches to inte-

guments and platysma of neck. neck. Whilst this branch is beneath the platysma it joins with the facial nerve. The platysma receives branches from this nerve.

The *descending branch* likewise passes through the platysma, and is distributed below the preceding, reaching as low as the sternum.

Dissection. *Dissection.*—Raise the platysma to the base of the jaw, and dissect out the cervical branches of the facial nerve that are beneath it. Clean also the deep fascia of the neck.

Branches of facial nerve to the neck. The *infra-maxillary branches of the facial nerve* (rami subcutanei colli) pierce the deep cervical fascia, and pass forwards beneath the platysma, forming arches across the side of the neck, which reach as low as the hyoid bone. Most of the branches end in the platysma, but a few filaments perforate it and supply the integument. Beneath the muscle there is a communication established between these branches of the facial and the superficial cervical nerve.

Cervical fascia in front of sterno-mastoid The *deep cervical fascia*, before the sterno-mastoideus, is stronger than it is behind that muscle, and has the following disposition. Near the sternum the fascia forms a white firm membrane, which is attached to that bone; but higher in the neck it becomes thinner, and is fixed to the base of the jaw and the zygoma, covering the parotid gland. From the angle of the jaw a piece is prolonged downwards between the parotid and sub-maxillary glands, to join the styloid process; this piece is named *stylo-maxillary ligament*. Intermuscular partitions are sent between the muscles, and the layer beneath the sterno-mastoid assists in forming the sheath of the cervical vessels. One of these layers, beneath the sterno-thyroid muscle, descends in front of the great vessels at the root of the neck to the arch of the aorta and to the pericardium.

forms stylo-maxillary ligament and sheath of vessels.

Dissection. *Dissection of the anterior triangular space.*—Raise the deep fascia of the neck towards the middle line, and clean the surface of the hyoid muscles, dissecting out at the same time the anterior jugular vein. Next expose the parts that occupy the anterior triangle by taking away the fat and fascia, but without displacing or injuring them. In removing the sheath of the cervical vessels, as these appear from beneath the muscles at the lower part of the neck, the dissector should be careful of the small descending branch of the ninth nerve in front of it. In the sheath between the vessels (carotid artery and jugular vein) will be found the pneumo-gastric

Seek small nerves.

nerve, and behind the same the sympathetic nerve. Follow upwards the trunks of bifurcation of the artery, especially the more superficial one (external carotid), whose numerous branches are to be traced as far as they lie in the space. Crossing the space, in the direction of a line from the mastoid process to the hyoid bone, are the digastric and stylo-hyoid muscles; and lying below them is the hypo-glossal nerve, which gives one branch (descendens noni) in front of the sheath, and another to the thyro-hyoid muscle. Directed downwards from beneath the same muscles to the sterno-mastoid muscle, is the spinal accessory nerve. On the inner side of the vessels, between the hyoid bone and the thyroid cartilage, the dissector will find the superior laryngeal nerve, and its small external laryngeal branch lying with the descending part of the superior thyroid artery. Lastly, clean the submaxillary gland close to the base of the jaw; and on partly dislodging it from the surface of the mylo-hyoid muscle, the student will expose the small branch of nerve to that muscle with the submental artery. The interval between the jaw and mastoid process is supposed to be cleared out by the removal of the parotid gland in the dissection of the facial nerve.

Trace arteries.

Laryngeal nerves,

and nerve to mylo-hyoid.

The ANTERIOR TRIANGULAR SPACE OF THE NECK contains the carotid artery and branches, and corresponds to the hollow on the surface of the neck in front of the sterno-mastoid muscle. This space is limited behind by the sterno-mastoid muscle. In front, along the middle line of the neck, it is bounded by the larynx and by the small muscles that reach from the hyoid bone to the lower jaw and sternum, viz. above the os hyoides by the mylo-hyoid and digastric muscles, and below that bone by the sterno-hyoid and sterno-thyroid muscles. The base of the triangle is directed upwards, and is marked by the base of the jaw, and a line prolonged from it to the sterno-mastoid muscle; whilst the apex is below at the sternum. Over this space are placed the skin and superficial fascia, the platysma in part, the deep fascia, and the ramifications of the facial and superficial cervical nerves.

Triangular space in front of neck.

Boundaries.

In the area of the anterior triangular space, as it is above defined, are seen the ascending muscles of the hyoid bone, as high as the level of the cricoid cartilage. But above that spot the common carotid artery appears from beneath those muscles at the root of the neck, and divides into two large trunks opposite the upper border of the thyroid cartilage.

Contents of space.

Carotid artery;

its situation and bifurcation. Position of two trunks to one another. From the place of division these trunks are continued onwards beneath the digastric and stylo-hyoid muscles to the interval between the jaw and the mastoid process. At first the trunks lie side by side, the vessel destined for the internal parts of the head being more posterior of the two, but above the digastric one becomes superficial to the other. The more superficial artery is named external carotid, and furnishes many branches to the neck and to the outer part of the head, viz. some forwards to the larynx, tongue, and face; others backwards to the occiput and ear; and others upwards to the head. Branches. The deeper trunk, internal carotid, ascends to the head without branching, and is distributed to the interior of the skull. In close contact with the outer side of the common trunk and the internal carotid artery, is the large internal jugular vein, which receives branches in the neck corresponding to some of the branches of the artery.

Nerves in connection with the arteries. In connection, more or less intimate, with the large vessels, are the following nerves:—within the sheath of the vessels, between the carotid artery and jugular vein, is the pneumogastric nerve, and behind the sheath is the sympathetic nerve. Along the outer part of the vessels the spinal accessory nerve extends for a short distance till it pierces the sterno-mastoid muscle. Crossing over the vessels, so as to form an arch below the digastric muscle, is the hypo-glossal nerve, which gives downwards a branch (descendens noni) in front of the sheath. Opposite the hyoid bone the superior laryngeal nerve appears on the inner side of the internal carotid artery; and a little lower down is the external laryngeal branch of that nerve, with the descending branches of the thyroid artery. Between the two carotid arteries and higher in the neck than the superior laryngeal nerve, is the arch formed by the glosso-pharyngeal nerve.

Submaxillary gland Altogether in front of the vessels, and partly concealed by the jaw, is the submaxillary gland; and on the surface of the mylo-hyoideus is the small nerve to that muscle, with the submental artery. and thyroid body. On the side of the thyroid cartilage, between it and the common carotid artery, is the prominence of the thyroid body, covered by the sterno-thyroid muscle:

and in the female this body is much more strongly marked than in the male.

Peculiarities in the vessels.—The chief peculiarity to be now noticed refers to the division of the common carotid. The branching of that vessel may be removed from the upper border of the thyroid cartilage, either upwards or downwards, so that the trunk of the carotid may remain undivided till it is beyond the os hyoides, or it may end in branches opposite the cricoid cartilage. The division beyond the usual place is more frequent than the branching short of that spot. But there may be two trunks issuing from beneath the hyoid muscles instead of one, for the common carotid has been found divided after an extent of one inch and a half; and, as an extremely rare occurrence, the external and internal carotids may arise as distinct arteries from the arch of the aorta. Sometimes the artery corresponding to the common carotid ascends, without division, in the place of the external carotid, and furnishes branches to the neck and head.* In some cases the jugular vein and vagus nerve cover the common carotid artery, especially on the left side, and the veins joining the jugular may form a kind of plexus over the upper part of the common arterial trunk. The descendens noni nerve is frequently found in the sheath of the vessels.

Difference in the place of division of carotid.

Jugular vein and vagus alter position on left side.

Anterior jugular vein.—This small vein occupies the middle line of the neck, and its size is dependent upon the condition of the external jugular. Beginning in some small branches below the chin, the vein descends to the sternum, and then turns outwards, beneath the sterno-mastoid muscle, to open into the subclavian vein. In the neck the anterior and external jugular veins communicate. There are two anterior veins, one for each side, though one is usually larger than the other, and at the bottom of the neck they are joined by a transverse branch.

Anterior jugular vein

joins subclavian vein.

The STERNO-CLEIDO-MASTOID MUSCLE forms the prominence of the side of the neck, and by its position divides the lateral aspect of the neck into two triangular spaces. The muscle is narrower in the centre than at the ends, and is attached to the trunk by two heads of origin, which are separated by a cellular interval. The inner head is fixed by a tendon to the anterior part of the sternum, and the outer head has a wide

Sterno-mastoid muscle

has its origin at sternum.

* For fuller information here, and in other parts of the book, respecting the peculiarities of the vessels, reference may be made to the admirable work on "The Anatomy of the Arteries of the Human Body." By Richard Quain, F.R.S.

attachment to the sternal third of the clavicle. From this origin the heads are directed upwards, the internal passing backwards, and the external almost vertically; and are blended about the middle of the neck in a roundish muscle, which is *inserted* into the front of the mastoid process, and by a wide aponeurotic part into a rough surface of bone behind that process. The borders of the muscle correspond to the triangular spaces of the neck, and the anterior one is the guide to the position of the common carotid artery. By its cutaneous surface the sterno-mastoid is covered by the common integuments, by the platysma, by the external jugular vein and superficial branches of the cervical plexus (across the middle part), and by the deep fascia. If the muscle is cut through below and raised, it will be seen to lie on the following parts: — the clavicular origin lies over the anterior scalenus muscle; and the sternal attachment conceals the lower hyoid muscles, the common carotid artery, and the accompanying vein and nerves. After the union of the heads, the muscle is placed over the cervical plexus, and rests on the posterior scalenus and some other muscles of the back of the neck; also near the skull, on the digastric muscle and the occipital artery, and on a part of the parotid gland. The spinal accessory nerve perforates the muscular fibres about the upper third. The extent of the attachment to the clavicle varies, and in some bodies it may reach even to the trapezius.

(and insertion at skull; forms the prominence of side of neck. Position to other parts.)

The OMO-HYOID MUSCLE crosses beneath the sterno-mastoideus, and consists of two fleshy bellies united by a small round tendon. The *origin* of the muscle from the scapula, and the connections of the posterior part, are studied in the dissection of the back. From the intervening tendon, the anterior fleshy part is directed forwards along the border of the sterno-hyoid muscle, and is *inserted* into the os hyoides at the junction of the body and cornu. The anterior belly of the muscle is close beneath the fascia after escaping from the sterno-mastoid, and rests on the sterno-thyroid muscle. This muscle crosses the common carotid artery on a level with the cricoid cartilage.

(Omo-hyoid muscle begins at the scapula, and ends at hyoid bone. Connections.)

The STERNO-HYOID MUSCLE is a flat thin band nearer the middle line than the preceding. It *arises* from the posterior

(Sterno-hyoid muscle)

aspect of the sternum and the ligaments between that bone and the clavicle. From this spot the fibres ascend, and are *inserted* into the lower border of the body of the os hyoides close to the median line, and internal to the omo-hyoid muscle. One surface is in contact with the fascia, and is often marked by a tendinous intersection near the clavicle. When the muscle is divided and turned aside, the deep surface will be found to rest on the sterno-thyroideus and its continuation (thyro-hyoid), also on the superior thyroid vessels. The muscles of opposite sides are separated by a cellular interval which is largest below.

named from its attachments.

Parts above and beneath.

The origin of the muscle varies; sometimes it comes from the cartilage of the first rib, at other times from the clavicle.

Origin varies.

The STERNO-THYROID MUSCLE is wider and shorter than the sterno-hyoid, beneath which it lies. Like the other hyoid muscle, it *arises* from the posterior surface of the sternum, opposite the cartilage of the first or second rib, sometimes also from the contiguous cartilage; and is *inserted* into the oblique line on the side of the thyroid cartilage, where it is continuous with the thyro-hyoid muscle. The inner border corresponds to the muscle of the other side and to the thyroid veins, whilst the outer reaches the carotid artery. The superficial surface is concealed by the preceding hyoid muscles; and the opposite surface is in contact with the lower part of the carotid artery, the trachea, and the larynx with the thyroid body. A transverse tendinous line crosses the muscle near the sternum.

Sterno-thyroid muscle ? is named from its attachments.

Parts above and beneath.

The THYRO-HYOID MUSCLE is a continuation of the last. Beginning on the side of the thyroid cartilage, the fibres ascend to the body and the inner half of the great cornu of the os hyoides. On the muscle lie the omo-hyoideus and sterno-hyoideus; and beneath it are the superior laryngeal vessels and nerve. This is sometimes considered one of the special muscles of the larynx.

Thyro-hyoid a continuation of preceding to os hyoides.

Dissection of the subclavian artery. — The student should now take away (supposing the sterno-mastoid to be cut) the fat and fascia from the lower part of the neck, so as to expose the scaleni muscles, the remainder of the subclavian artery with its branches, and the cervical and brachial plexuses and their branches. By

Dissection of the subclavian artery.

means of a little dissection the anterior scalenus muscle will be seen ascending from the first rib to the neck, with the phrenic nerve lying obliquely on the surface, and the subclavian vein in front of it near the rib. Trace then the part of the subclavian artery that is on the inner side of the scalenus, and be careful not only of its branches, but of the branches of the sympathetic nerve, which course from the neck to the chest. This dissection will be facilitated by the removal of a part or the whole of the clavicle. All the branches of the artery are in general easily found, except the superior intercostal, which is to be sought in the thorax in front of the neck of the first rib. On the branch (inferior thyroid) ascending to the thyroid body, or near it, is the middle cervical ganglion of the sympathetic, and the dissector should follow downwards from it the small nerves to the thorax. Only the origin and first part of the course of the branches can now be seen; their termination is exposed in other stages of the dissection, or in the dissection of other parts of the body.

and branches

The brachial plexus.

The outer part of the subclavian artery having been already prepared, let the dissector remove more completely the cellular membrane from the nerves of the cervical and brachial plexuses. From the brachial plexus trace the small subclavian branch, and some branches of the rhomboid and serratus muscles, which pierce the posterior scalenus. If it is necessary, the anterior scalenus may be cut through after the artery has been studied.

Cervical plexus.

From the cervical plexus, besides the muscular branches, the student should seek small twigs to join the descendens noni, and should define the roots of the phrenic nerve. Lastly, let the surface of the posterior scalenus muscle be cleaned, as it lies beneath the cervical nerves.

Scalenus anticus reaches from first rib to cervical vertebræ;

The SCALENUS ANTICUS MUSCLE extends from the first rib to the lower cervical vertebræ. It is somewhat conical in shape, and the apex or lower part *arises* from the inner border and upper surface of the first rib, in front of a slight depression; whilst the base is *inserted* into the anterior tubercles of four of the cervical vertebræ, from the sixth to the third, inclusive.

has numerous connections with muscles, vessels,

More deeply seated below than above, the muscle is concealed by the clavicle and subjacent muscle (subclavius), and by the clavicular part of the sterno-mastoid: the phrenic nerve lies along the muscle, and the subclavian vein crosses over it near the rib. Along the inner border is the internal jugular vein. Beneath the scalenus are the nerves of the brachial

and nerves.

plexus and the subclavian artery. At the origin from the rib there is often a small projecting point of bone (tubercle); and the insertion corresponds to the origin of the rectus capitis anticus major muscle.

The SCALENUS POSTICUS MUSCLE is larger than the anterior, and is bifid at its attachment to the ribs. One process of *origin* is attached to the upper surface of the first rib behind the groove for the subclavian artery, and the other is connected to the second rib between the tubercle and angle. The muscle ascends behind the spinal nerves, and is *inserted* into the posterior tubercles on the transverse processes of the lower six cervical vertebræ. In contact with the anterior surface are the subclavian artery and the spinal nerves, together with the sterno-mastoid muscle, whilst the posterior surface touches the deep muscles of the back of the neck. The outer border is perforated by the nerves of the rhomboid and serratus muscles. Scalenus posticus attached to ribs and cervical vertebræ. Parts in contact with it.

It may here be remarked that many writers divide this mass into two muscles corresponding to the separate attachment to the ribs. Thus the larger piece which is attached to the first rib is named *middle scalenus*, whilst the small part, connected to the second rib, is the *posterior scalenus* of the same authors. Number of scaleni stated differently.

The SUBCLAVIAN ARTERY is the commencement of the large vessel that supplies the upper limb with blood, and has received this name from its position beneath the clavicle. The vessel is derived from the branching of the innominal artery behind the sterno-clavicular articulation, and it remains subclavian as far as the lower border of the first rib. To reach the limb the artery crosses the lower part of the neck, taking an arched course over the bag of the pleura and the first rib, and between the scaleni muscles. For the purpose of describing its numerous connections, the artery may be divided into three parts: the first extending from the sterno-clavicular articulation to the inner border of the anterior scalenus; the second, beneath the scalenus; and the third, from the outer border of that muscle to the lower edge of the first rib. Subclavian artery extends to upper limb, and is divided into three parts

First part.—Internal to the anterior scalenus the artery is deep in the neck, and ascends slightly from its origin. First part internal to

scalenus is deep. Between the vessel and the surface will be found the common tegument and the deep fascia, the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, and a deep process of fascia from the inner border of the scalenus muscle. Crossing the artery near the scalenus is the internal jugular vein with the small vertebral vein, and internal to these veins is the pneumogastric nerve. Some branches of the sympathetic are likewise placed in front of the vessel. This part of the subclavian lies over the longus colli muscle, though at some distance from it, and separated from it by cellular membrane, by the recurrent branch of the pneumogastric nerve, and by the sympathetic nerve. Below the artery, both in this and the next part, is the pleura, which ascends into the arch formed by the vessel. Three branches arise from the subclavian in this part of its extent.

Parts in front, behind, below. Branches.

Second part beneath scalenus. *Second part.*—Beneath the scalenus the vessel is less deep than it is when internal to that muscle, and at this spot it rises highest in the neck. This second part, like the first, is covered by the integuments and deep fascia, then by the clavicular origin of the sterno-mastoideus, and lastly by the anterior scalenus with the phrenic nerve. Behind the vessel is the posterior scalenus. And above it, in the interval between the scaleni, are the large trunks of the lower cervical nerves, with the exception of the trunk formed by the union of the last cervical and first dorsal, that lies between the artery and the posterior scalenus. The subclavian vein is below the level of the artery, and separated from it by the scalenus muscle. From this part of the subclavian one branch takes its origin.

Parts in front, behind, above. Branches.

Third part is superficial. *Third part.*—Beyond the scalenus the subclavian artery is contained in the clavicular part of the posterior triangular space (p. 51.), and is nearer the surface than in the rest of its course. This part of the artery is comparatively superficial, whilst in the space before mentioned, for it is covered only by the integuments, platysma, and deep fascia, with some superficial nerves of the cervical plexus; but near its termination the vessel gets under cover of the clavicle and subclavius muscle, and the supra-scapular artery and vein. In the third part of its course the artery rests on the surface of

Parts covering it; beneath it;

the first rib. Above the vessel is the brachial plexus, and below it is the subclavian vein. Usually no branch leaves the last part of the artery. above and below.

Peculiarities of the artery.—With reference to the origin, in one case it may be above the sterno-clavicular articulation; in another, below that joint. Or the artery may spring as a separate trunk from the arch of the aorta; and in such a state of the parts, the vessel takes a deeper place than usual to reach the scaleni muscles: a condition that will be referred to with the arch of the aorta in the thorax. It has been before said that the artery may be in front of the scalenus, or in its fibres, and that the vein may be beneath that muscle. Peculiarities of origin of the trunk;

The branches of the first part of the artery arise near the scalenus muscle, so as to leave an interval at the origin free from offsets. This interval varies in length, being from half an inch to an inch in the greater number of cases; and its extremes range from somewhat less than half an inch to an inch and three quarters. (*Quain.*) of the branches.

Branches of the subclavian.— Usually there are four branches to the subclavian artery. Three of these arise from the first part of the arterial trunk; one (vertebral) ascends in the neck, another (internal mammary) descends to the chest, and the remaining one (thyroid axis) is a short thick trunk, which furnishes branches inwards and outwards. The fourth branch (superior intercostal) arises from the second part of the artery, or beneath the anterior scalenus, and gives off the deep cervical branch. If there is a branch present on the third part of the artery, it is commonly the posterior scapular. Branches of subclavian artery.

1. The *vertebral artery* is generally the first and largest branch of the subclavian, and arises from the upper and posterior part of that vessel. Ascending between the contiguous borders of the scalenus and longus colli muscles, this branch enters the aperture in the transverse process of the sixth cervical vertebra, and is continued upwards to the foramen magnum of the skull, through the chain of foramina in the tranverse processes of the other cervical vertebræ. Before the artery enters the transverse process it is partly concealed by the internal jugular vein, and passes beneath the thyroid artery; it is accompanied by branches of the sympathetic nerve, and supplies small muscular branches. Its course and distribution will be given afterwards. Vertebral artery in the neck. Small branches.

On the left side the commencement of the vertebral artery is crossed by the thoracic duct. On left side.

Difference in place of origin. The origin of the vertebral may vary in its position along the first part of the trunk of the subclavian: or it may be transferred to the arch of the aorta, especially on the left side, or to the right common carotid artery, when the subclavian of the same side arises from the aorta. The course of the artery is not constant through the hole in the transverse process of the sixth vertebra; it may enter any other as high as the second.

Vertebral vein, and branches. The *vertebral vein* is superficial to its artery in the neck, and is directed over the subclavian artery to join the subclavian vein; it receives the *deep cervical vein* and the *branch* that accompanies the ascending cervical artery.

Internal mammary artery in the neck. 2. The *internal mammary branch* leaves the lower part of the subclavian artery, and coursing downwards beneath the clavicle and subjacent muscle, and the subclavian vein, enters the thorax between the first rib and the bag of the pleura. As the artery is about to enter the chest, it is crossed (superficially) by the phrenic nerve. The distribution of the vessel to the walls of the chest and abdomen will be seen with the dissection of those parts.

Thyroid axis 3. *Thyroid axis.*—This is a short thick trunk, that arises from the front of the artery near the anterior scalenus muscle, and soon divides into three branches: — one to the thyroid body, and two to the scapula that run outwards across the neck. On the left side of the body the thoracic duct lies in front of the thyroid axis.

divides into three.

Supra-scapular branch. *a.* The *supra-scapular branch* courses outwards across the lower part of the neck, beneath the clavicle and subclavian muscle to the superior costa of the scapula, and entering the supra-spinal fossa is distributed to the muscles on the dorsum of that bone. The connections of this artery are seen in the dissection of the back.

Transverse cervical branch. *b.* The *transverse cervical branch*, usually larger than the preceding, takes a similar direction, though higher in the neck, and ends beneath the border of the trapezius muscle in the superficial cervical and posterior scapular arteries. (See "Dissection of the Back.") In its course outwards this artery crosses the anterior scalenus, the phrenic nerve, and the brachial plexus, and lies in the upper part of the space that contains the third part of the subclavian artery, the supra-scapular artery lying along the base of the same space. Some small branches are supplied by it to the posterior triangular space of the neck.

Offsets.

Place of origin varies. Though the transverse cervical artery supplies ordinarily the posterior scapular branch, there are many examples in which, though holding its usual position in the neck, it is too small in size to give origin to so large an offset. In such instances the diminished artery ends in the trapezius muscle, whilst the posterior scapular branch arises separately from the third, or even the second part of the subclavian artery.

Inferior c. The *inferior thyroid branch* is the largest offset of the thyroid

axis. Directed inwards to the thyroid body, the artery passes beneath the common carotid artery with its accompanying vein and nerves, and in front of the longus colli muscle and the recurrent nerve. In this course the vessel is tortuous. At the lower part of the thyroid body it divides into branches that enter the structure of that body, whilst others communicate with the superior thyroid and the corresponding artery of the opposite side, forming a very free anastomosis between these vessels. Near the larynx a *laryngeal branch* is distributed to the back of that tube, and other offsets are furnished to the trachea. Thyroid branch. Gives laryngeal offset.

The *ascending cervical artery* is a branch of the thyroid near its commencement; it is directed upwards between the scalenus and rectus capitis anticus major, and ends in branches to those muscles and to the posterior triangle of the neck. Some small spinal branches are conveyed along the spinal nerves to the cord and its membranes. and ascending cervical branch.

In connection with the thyroid artery may be noticed a third thyroid artery, which has been named *lowest thyroid* (art. thyroidea ima). This small branch usually comes from the trunk of the innominal artery, but it may spring from the common carotid, or from the arch of the aorta. Whatever its origin, the small vessel ascends in front of the trachea to the thyroid body, and either takes the place of an absent inferior thyroid artery, or assists a smaller vessel than usual in supplying that body. Accessory branch to the lower thyroid.

The *veins* corresponding to the branches of the thyroid axis have the following destination:—those with the supra-scapular and transverse cervical arteries open in the external jugular vein. But the inferior thyroid vein begins in a plexus connected with the thyroid body, and descends in front of the trachea, beneath the muscles covering it, to end in the innominal vein. Veins corresponding to arteries.

4. The *superior intercostal artery* arises from the posterior part of the subclavian, and bends downwards over the neck of the first rib to the thorax. Its distribution to the first two intercostal spaces will be seen in the thorax. Superior intercostal artery in neck.

Arising in common with this branch is the *deep cervical artery* (art. profunda cervicis). Analogous to the dorsal branch of an intercostal artery, it bends backwards between the transverse process of the last cervical vertebra and the first rib, and ends beneath the complexus muscle at the posterior part of the neck. Deep cervical artery.

The SUBCLAVIAN VEIN has the same limits as the artery of the same name, viz. between the lower border of the first rib and the sterno-clavicular articulation. It is a continuation upwards of the axillary vein, and ends by joining the Subclavian vein.

internal jugular to form the innominate vein. Its course is nearly straight, but below the level of the artery, from which it is separated by the anterior scalenus muscle. The external jugular joins this vein outside the scalenus, and the vertebral and superior intercostal veins enter it inside that muscle. Into the angle of union of the subclavian and jugular veins the right lymphatic duct opens; and at the same spot, on the left side, is the entrance of the left lymphatic duct.

Its branches; opening of lymphatic ducts.

Cervical nerves.

The ANTERIOR DIVISIONS OF THE CERVICAL NERVES spring from the common trunks of the spinal nerves in the intervertebral foramina, and appear on the side of the neck between the inter-transverse muscles. Eight in number, the nerves are equally divided between the cervical and the brachial plexus, the highest four being combined in the former, and the remaining nerves in the latter plexus. At their commencement the nerves receive offsets of communication from the sympathetic, and they are further intermixed by communicating branches.

Position and number.

First two differ from rest.

To this general statement it is necessary to make exception respecting the first two nerves; and the peculiarities here referred to will be verified in *Section* 18.

Brachial plexus formed by five nerves.

BRACHIAL PLEXUS. — The first dorsal and four lower cervical nerves are blended in this plexus, and a fasciculus is added to them from the lowest nerve entering the cervical plexus. Thus formed the plexus reaches from the lowest part of the neck to the axilla, where it ends in nerves for the upper limb. Only the part above the clavicle can now be seen. In the neck the nerves have but little of a plexiform arrangement: they lie at first between the scaleni muscles, and have the following disposition: —

Disposition of nerves in the plexus in the neck.

The fifth and sixth nerves unite near the vertebræ; the seventh remains distinct as far as the outer border of the posterior scalenus; and the last cervical and first dorsal are blended in one trunk beneath the anterior scalenus; so that they are combined at first into three cords. Near the attachment of the posterior scalenus to the rib, the seventh nerve throws itself into the trunk formed by the fifth and sixth, and there then result two cords to the plexus: — the one formed by the fifth, sixth, and seventh cervical nerves; and the other, by the eighth cervical and the first dorsal nerve. These two trunks accompany the

subclavian artery, lying to its acromial side, and are continued to the axilla, where they are more intimately blended.

Branches.—The branches of the plexus may be classed into those above the clavicle, and those below that bone. The highest set end chiefly in the muscles of the lower part of the neck, of the chest, and of the shoulder; whilst the other set consist of the terminal branches, and are furnished to the upper limb. Branches in the neck are

BRANCHES ABOVE THE CLAVICLE.—1. *Branch to the phrenic nerve.* This offset comes from the trunk of the fifth cervical nerve, and joins the phrenic on the anterior scalenus muscle. Phrenic nerve,

2. The *branch of the subclavius muscle* is a very slender twig, that arises from the trunk formed by the fifth and sixth nerves, and is directed downwards over the subclavian artery to the under-surface of the muscle; it is often united with the phrenic nerve at the lower part of the neck. Nerve of subclavius,

3. The *branch for the rhomboid muscle* springs from the fifth nerve in the substance of the posterior scalenus, and perforates the fibres of that muscle; it is afterwards directed beneath the levator anguli scapulæ to its destination. Branches are usually given from this nerve to the levator anguli scapulæ. Nerve of rhomboideus,

4. The *posterior thoracic nerve* (nerve of the serratus; external respiratory nerve of Bell) is contained in the scalenus, like the preceding, and arises from the fifth and sixth nerves, near the intervertebral foramina. Piercing the fibres of the scalenus lower than the preceding branch, the nerve is continued behind the brachial plexus, and enters the serratus magnus muscle on the axillary surface. Nerve of serratus,

5. *Branches of the scaleni and longus colli muscles.*—These are small twigs that are seen when the anterior scalenus is divided; they arise from the trunks of the nerves as soon as these leave the spinal canal. Nerves of scaleni and longus colli,

6. The *supra-scapular nerve* is larger than either of the others. It arises from the upper cord of the plexus, and is traced to the dorsum of the scapula in the dissection of the back. Supra-scapular nerve.

The CERVICAL PLEXUS is formed by the anterior divisions of the first four cervical nerves. Situate at the upper part of the neck, it lies beneath the sterno-mastoid muscle, and on the posterior scalenus and levator anguli scapulæ. Its appearance differs much from that of the brachial plexus, for it resembles a network more than a bundle of large Cervical plexus is

formed by branching of the nerves. cords. The following is the general arrangement of the nerves in the plexus: — each nerve, except the first, divides into an ascending and a descending branch, and these unite with similar parts of the contiguous nerves, so as to give rise to a series of arches. From these loops or arches the different branches arise.

Its offsets are superficial, *Branches.* — The branches of the plexus are either superficial or deep. The superficial set are described with the triangular space of the neck (p. 53.) as consisting of ascending and descending nerves. In this stage of the dissection the ascending branches are seen to spring from the union of the second and third nerves, and the descending ones to come

and deep branches. from the loop between the third and fourth nerves. The deep set of branches remain now to be examined.

Deep branches are, The DEEP BRANCHES OF THE PLEXUS are either muscular or communicating, and may be arranged into an internal and an external series.

Phrenic nerve, A. INTERNAL SERIES. — 1. The *phrenic nerve* is derived from the third and fourth nerves of the plexus, and is usually joined by a fasciculus from the fifth cervical nerve. Descending obliquely on the surface of the anterior scalenus, it enters the chest in front of the internal mammary artery, but behind the subclavian vein. The final distribution of the nerve is to the diaphragm. At the lower part of the neck the phrenic nerve is joined by a filament of the sympathetic, and sometimes by an offset of the nerve of the subclavius muscle.

Nerves to join descendens noni, 2. The *branches communicating with the descendens noni* are two in number. One of the branches arises from the second, and the other from the third cervical nerve; they are directed inwards either over or under the internal jugular vein, and communicate with the descending muscular branch of the ninth nerve.

Branches of recti, 3. *Muscular branches* are furnished to the recti muscles; these arise from the loop between the first two nerves, and from the trunks of the other nerves close to the intervertebral foramina.

Branches to other nerves. 4. Some *connecting branches* pass from the loop between the first two nerves to the sympathetic, and the cranial nerves near it; these will be afterwards referred to.

Branches to other muscles, B. EXTERNAL OR POSTERIOR SERIES. — 1. *Muscular branches* are given from the second nerve to the sterno-mastoideus; from the third nerve to the levator anguli scapulæ; and from the third

and fourth nerves to the trapezius. Further, some small branches supply the substance of the posterior scalenus.

2. *Connecting branches with the spinal accessory nerve.* — The communications between this cranial and the spinal nerves are numerous. First, in the sterno-mastoid muscle; next, in the posterior triangular space; and, lastly, beneath the trapezius. The union with those branches that are distributed to the trapezius has almost the appearance of a plexus. Branches joining spinal accessory.

The COMMON CAROTID ARTERY is the chief vessel for the supply of blood to the neck and head, and is remarkable in not furnishing collateral branches. The origin of the vessel is different on the two sides of the body. Common carotid artery.

The artery of the right side commences opposite the sterno-clavicular articulation at the bifurcation of the innominal artery, and ends at the upper border of the thyroid cartilage, by dividing into two trunks, external and internal carotid arteries. The course of the artery is along the side of the trachea and larynx, gradually diverging from the vessel of the opposite side, in consequence of the increasing size of the larynx; and its position will be marked by a line drawn to the sterno-clavicular articulation from a point midway between the angle of the jaw and the mastoid process. Contained in a sheath of cervical fascia, with the internal jugular vein to the outside, and the pneumogastric nerve between the two, the carotid artery has the following connections with the surrounding parts:—as high as the cricoid cartilage the vessel is deeply placed, and is concealed by the common teguments and fasciæ, and by the muscles at the lower part of the neck, viz. sterno-mastoid (sternal origin), sterno-hyoid, sterno-thyroid, and omo-hyoid; and beneath the muscles by the middle thyroid vein. But above the cricoid cartilage to its termination the artery lies near the surface, and is covered only by the common investments of the part; superficial to it here is the descendens noni nerve, and crossing the upper part are the superior thyroid veins. The vessel rests on the longus colli muscle, on the sympathetic nerve and branches, also on the recurrent nerve and the inferior thyroid artery. To the inner side of the carotid lie the trachea and larynx, with the œsophagus and the thyroid Origin. Course. Situation. Parts covering it. beneath it. and on its sides.

body, the last overhanging the vessel by the side of the larynx. Along the outer side of the carotid sheath is a chain of lymphatic glands.

Internal jugular vein

INTERNAL JUGULAR VEIN.—Only the part of this vein that accompanies the common carotid artery is now seen. Placed on the outer side of the artery, the vein ends below by uniting with the subclavian in the innominate vein. Its proximity to the carotid is not equally close in all the extent of that vessel, for at the lower part of the neck the vein inclines outwards, leaving a space between it and the artery, in which is seen the vagus nerve, about midway between the two. In this part of its course the vein receives the superior and middle thyroid branches.

lies close to side of artery, except below. Branches.

Differences observed in carotid.

Peculiarities in the carotid artery.—Usually the common carotid is without branch, but it may give origin to the superior thyroid, the inferior thyroid, or the vertebral artery. Mention has been made of the fact, that occasionally the common carotid artery is not divided into two. (see page 59.).

Dissection.

Dissection.—Trace out completely the trunk of the external carotid, and follow the branches until they disappear beneath different parts. Separate from one another the digastric and stylo-hyoid muscles, which cross the carotid, and define their origin and insertion.

Digastric muscle has two bellies,

The DIGASTRIC MUSCLE consists of two fleshy bellies, united by an intervening tendon, whence its name. The posterior belly *arises* from the digastric fissure and the anterior border of the mastoid process, whilst the anterior belly takes origin from the base of the lower jaw, on the side of the symphysis. From these places of origin the fibres are directed to the intervening tendon. Those of the posterior belly are the longest, and are inclined obliquely forwards, and those of the anterior belly pass downwards, but less obliquely. The tendon of the muscle is surrounded by fibres of the stylo-hyoideus, and is attached to the side of the os hyoides by means of a membranous expansion from its lower border.

which are joined by a tendon.

Position to other parts.

The arch formed by the digastric is superficial, except at the outer part, where it is beneath the sterno-mastoid muscle. The posterior belly crosses the carotid vessels and the accompanying veins and nerves, and the anterior rests

on the mylo-hyoid muscle. The direction of the posterior belly across the anterior triangular space of the neck is that of a line from the mastoid process to the hyoid bone; and along its lower border will be found the occipital artery and the hypo-glossal nerve, the former passing backwards, the latter forwards.

The digastric muscle describes an arch across the side of the neck, and forms the lower boundary of a space that reaches upwards to the jaw and in front of the ear. This space is divided into two parts by the stylo-maxillary ligament. In the posterior part are contained the parotid gland and the vessels and nerves in connection with it (p. 28.); in the anterior are the submaxillary gland and the facial vessels, and deeper still the muscles between the chin and the hyoid bone. The muscle bounds a space that contains parotid and submaxillary glands.

The STYLO-HYOID MUSCLE is thin and slender, and has the same position as the posterior belly of the digastric. It *arises* from the outer aspect of the styloid process, about the middle, and is *inserted* into the body of the os hyoides: the fleshy fibres are usually perforated by the tendon of the digastric. The muscle has the same connections as the digastric (posterior belly). In many bodies the stylo-hyoid muscle is absent. Stylo-hyoideus. Origin. Insertion. Surrounds digastric tendon.

The HYPO-GLOSSAL NERVE (ninth cranial) may now be examined in the anterior triangle of the neck. Appearing at the lower edge of the digastric muscle, the nerve hooks round the occipital artery, and is then directed forwards below the digastric, disappearing beneath the mylo-hyoid muscle. As the nerve crosses the neck, it lies over the carotid vessels, and near the cornu of the os hyoides it crosses the lingual artery, so as to become higher than it. Ninth nerve in the anterior triangle.

Branches.—In this part of its course the nerve gives the descendens noni branch, and a small muscular offset to the thyro-hyoideus. Its branches here are muscular.

The *descending branch* (ram. descend. noni) arises from the trunk of the hypo-glossal on the outer side of the carotid artery, and descends on the front, or in the sheath of the vessel, to about the middle of the neck, where it is joined by the communicating branches of the cervical nerves. After the union of the spinal Branch of lower hyoid muscles; is joined

with cervical nerves

nerves the descendens noni ends in muscular branches for the supply of the lower hyoid muscles, viz. omo-hyoid (both bellies), sterno-hyoid, and sterno-thyroid. Sometimes another offset is continued to the thorax, where it joins the phrenic and cardiac nerves.

by intercommunicating fibres.

The connection between the descendens noni and the spinal nerves is formed by two or more cross filaments, in the form of an arch with the concavity upwards; and M. Cruveilhier describes an interchange of filaments between the two sets of nerves.

External carotid vessel.

The EXTERNAL CAROTID ARTERY springs from the bifurcation of the common carotid at the upper border of the thyroid cartilage, and furnishes branches to the face, the neck, and the outer parts of the head.

Extent.

From the place of origin the vessel ascends to the interval between the jaw and the mastoid process, and ends near the condyle of the jaw, in the internal maxillary and temporal branches.

Course and direction.

In this extent the artery is at first on the inner side of the internal carotid, but it afterwards becomes superficial to that vessel; and its course is somewhat arched forwards, though the direction would be marked sufficiently by a line from the front of the meatus of the ear to the cricoid cartilage.

Parts superficial to it,

At first the external carotid is comparatively superficial, and easily reached from the surface, being overlaid only by the common coverings of the anterior triangular space, viz. the skin, the superficial and deep fasciæ with the platysma, and the superficial nerves. But above the situation of a line extended from the mastoid process to the hyoid bone the carotid artery is crossed by the digastric and stylo-hyoid muscles with the hypo-glossal nerve; and still higher it enters the substance of the parotid gland, where it lies beneath the facial nerve and the external jugular vein. The external carotid is also crossed by the branches of veins joining the internal jugular trunk.

beneath it,

The artery lies on the inferior and middle constrictor muscles of the pharynx and on the superior laryngeal nerve; then above the angle of the jaw on the stylo-glossus and stylo-pharyngeus muscles, and the glosso-pharyngeal nerve, which separate it from the internal carotid.

and on

To the inner side of the vessel is the os

hyoides with the muscles passing from it to the jaw, and still higher is the stylo-maxillary ligament. inner side.

The *branches* of the external carotid are numerous, and are classed into anterior, posterior, and ascending sets. The anterior set comprise branches to the thyroid body, the tongue, and the face, viz. superior thyroid, lingual, and facial arteries; in the posterior set are the occipital and posterior auricular branches; and the ascending set include the ascending pharyngeal, temporal, and internal maxillary arteries. Besides these, the carotid gives other branches to the sterno-mastoid muscle and the parotid gland. Its branches are anterior, posterior, and ascending.

All the branches, except the ascending pharyngeal, lingual, and internal maxillary, may now be examined; but the three referred to will be afterwards described with the regions they occupy. Branches now seen are

The *superior thyroid artery* arises near the cornu of the os hyoides, and turns downwards on the inner side of the common carotid artery, passing beneath the omo-hyoid, sterno-hyoid, and sterno-thyroid muscles, to the thyroid body, to which it is distributed on the anterior aspect. This branch is superficial in the anterior triangle, and furnishes offsets to the lowest constrictor as well as to the muscles beneath which it passes, in addition to the following named branches: — Superior thyroid, has offsets to

a. The *hyoid branch* is very inconsiderable in size, and runs inwards below the hyoid bone; it supplies the parts attached to that bone, and anastomoses with the vessel of the opposite side. the hyoid bone,

b. A branch for the *sterno-mastoid muscle* lies in front of the sheath of the common carotid artery, and is distributed chiefly to the muscle from which it takes its name. sterno-mastoid muscle,

c. The *laryngeal branch* pierces the membrane between the hyoid bone and thyroid cartilage, with the superior laryngeal nerve, and ends in the interior of the larynx. to larynx,

d. A small *crico-thyroid branch* is placed on the membrane between the cricoid and thyroid cartilages, and communicates with the corresponding artery of the opposite side, forming an arch. to crico-thyroid membrane.

The *superior thyroid vein* commences in the larynx and the thyroid body, and crosses the end of the common carotid artery, to open into the internal jugular vein. Accompanying vein.

The *facial artery* arises above the lingual, and is directed upwards over the lower jaw to the face. In the neck the artery passes beneath the digastric and stylo-hyoid muscles, and is afterwards Facial artery

received into the submaxillary gland, on which it makes a remarkable sigmoid turn. Its disposition in the face has been examined (p. 25.). The cervical part of the artery gives branches to the pharynx and to the parts below the jaw, viz.:

supplies branches in the neck

to the palate,

a. The *inferior palatine branch* ascends to the pharynx beneath the jaw, and between the stylo-glossus and stylo-pharyngeus muscles. In its course it furnishes a branch to the tonsil, and is then distributed to the soft palate. This branch frequently arises from the ascending pharyngeal artery.

tonsil,

b. The *tonsillar branch* is smaller than the preceding, and ascends between the internal pterygoid and stylo-glossus muscles. Opposite the tonsil it perforates the constrictor muscle, and ends in branches to that body.

submaxillary gland and mylo-hyoid muscle.

c. Glandular branches are supplied to the submaxillary gland, and are given from the part of the artery in contact with it.

d. The *submental branch* arises near the inferior maxilla, and passes forwards on the mylo-hyoid to the anterior belly of the digastric muscle, where it distributes branches: some of these turn over the jaw to the chin and lower lip, and the rest supply the muscles between the jaw and the hyoid bone, one or two perforating the mylo-hyoideus to anastomose with the sublingual artery.

Facial vein.

The *facial vein* joins the internal jugular vein. In the cervical part of its course it receives branches corresponding to those of the artery.

Occipital artery

The *occipital artery* is of considerable size, and is destined for the back of the head. It arises from the carotid opposite the facial branch, and at the lower border of the digastric muscle. From this spot the artery ascends to the inner part of the mastoid process of the temporal bone; next it turns horizontally backwards on the occipital bone, passing above the transverse process of the atlas, and finally becomes cutaneous (p. 5.). In the neck this artery passes beneath the digastric muscle and part of the parotid gland, and crosses over the internal carotid artery, the jugular vein, and the spinal accessory and hypo-glossal nerves.

ends on occiput; in neck has an offset to the dura mater.

The only offset from the artery in the front of the neck is a small *meningeal branch* of the dura mater in the posterior fossa of the base of the skull. It ascends along the internal jugular vein, and enters the skull by the foramen lacerum.

Occipital vein.

The *occipital vein* has the same course as the artery, and opens into the internal jugular, sometimes into the external jugular vein.

Posterior auricular

The *posterior auricular artery* is smaller than the preceding branch, and takes origin above the digastric muscle. Ascending

in the same direction as the occipital artery, viz. to the interval between the ear and the mastoid process, it divides into two final branches for the ear and occiput (p. 5.). artery in neck supplies

A small branch, *stylo-mastoid*, enters the foramen of the same name, and supplies the internal ear. a branch to the ear.

The *vein* with the artery terminates in the trunk formed by the temporal and internal maxillary veins. Vein with artery.

The *temporal artery* is in direction the continuation of the external carotid, and is one of the terminal branches of that artery. Ascending through the parotid gland, in the interval between the ear and the articulation of the jaw, the vessel crosses the posterior root of the zygoma, and divides on the temporal fascia (about two inches above the zygoma) into anterior and posterior branches for the front and side of the head (p. 5.). The trunk of the artery gives offsets to the surrounding parts: thus, Temporal artery, besides terminal branches, gives

a. Parotid branches are furnished to the gland as this conceals the artery. *Articular* twigs are supplied to the articulation of the lower jaw, and other *muscular* branches enter the masseter. Some *anterior auricular* branches are also distributed to the pinna and the meatus of the external ear. branches to parotid, to articulation of jaw, and the ear.

b. The *transverse facial branch* quits the temporal artery opposite the condyle of the jaw, and is directed forwards over the masseter muscle; on the side of the face it supplies the muscles and the integuments, and anastomoses with the facial artery. Branch to face.

c. The *middle temporal branch* arises just above the zygoma, and pierces the temporal aponeurosis to enter the substance of the temporal muscle. In the muscle it anastomoses with branches of the internal maxillary artery. Branch of temporal muscle

d. A small branch of the temporal artery is likewise found between the layers of the temporal fascia; this becomes cutaneous near the orbicularis muscle. and of the temple.

The *temporal vein* commences on the side of the head, and is contiguous to its artery. Near the zygoma it is joined by the middle temporal vein, next by other branches corresponding to those of the artery; and finally it ends by uniting with the internal maxillary to give rise to the external jugular vein. Corresponding vein.

Peculiarities of the external carotid artery. — The deviations from the usual place of origin, and the occasional connection of the external carotid with the arch of the aorta were alluded to in the peculiarities of the common carotid artery (p. 59.). The regular origin of the branches, as described above, may also be departed from by means of the closer aggregation of these branches on the trunk of the carotid. Branches of external carotid change in origin

and in number. Further, the usual number may be diminished by two or more taking origin by a common trunk; or the number may be increased by some of the secondary branches being transferred to the trunk of the external carotid.

Section VI.

PTERYGO-MAXILLARY REGION.

Contents of the region. In this region the dissector will find the masseter muscle on the side of the jaw; and in the space beneath the ramus of the jaw are contained the pterygoid muscles, the internal maxillary artery, and the commencement of the inferior maxillary trunk of the fifth nerve.

Dissection. *Dissection.*—Cut through the branches of the facial nerve and the transverse facial artery, and turn them backwards off the face; then clean the fibres of the masseter muscle, defining its origin and following its insertion into the ramus of the lower jaw. Take out of the mouth the material that made tense the fibres of the orbicularis, if any of it remains.

Masseter has two parts. The MASSETER MUSCLE conceals the ramus of the lower jaw, and presents at the anterior border, near its attachment to the zygoma, an aponeurosis, which projects into the muscle, and divides it into two parts.

Superficial is directed backwards. Deep part forwards. The superficial part *arises* from the two anterior thirds of the zygomatic arch, and its fibres are directed downwards and backwards to be *inserted* into the angle, and the lower half of the ramus of the jaw. The deeper part takes *origin* by fleshy fibres from the remaining third and the posterior aspect of the arch; and its fibres, taking an opposite direction to those of the superficial part, are *inserted* into the outer surface of the coronoid process and the ramus of the jaw above the other fibres of the muscle.

Muscle nearly subcutaneous; lies on the jaw. The lower part of the masseter is subcutaneous, but the upper is partly concealed by the parotid gland (socia parotidis), and is crossed by Stenson's duct, and by the transverse facial vessels and the facial nerve. The anterior border projects over the buccinator muscle, and a quantity of fat resembling that in the orbit is found beneath it. The muscle covers the ramus of the jaw, and the masseteric branch of nerve and artery that enter it by the under-surface.

Dissection.—Detach the temporal fascia from the upper border of the zygomatic arch, and remove it from the surface of the temporal muscle. Next the arch is to be sawn through in front and behind, so as to include its whole extent. Throw down the zygomatic arch with the masseter muscle still attached to it, and separate the fibres of that muscle from the upper half of the ramus of the jaw, seeking, at the same time, the masseteric nerve and artery that appear through the sigmoid notch. The surface and the insertion of the temporal muscle may then be cleaned. Afterwards saw off the coronoid process by a cut passing from the centre of the sigmoid notch nearly to the last molar tooth, in order to include the whole of the insertion of the temporal muscle; and in doing this be careful of the buccal artery and nerve issuing from beneath. Lastly, raise up the coronoid process, and separate the lower fibres of the temporal muscle from those of the external pterygoid, close below them. Dissection.

The upper attachment of the temporal muscle has been seen (p. 4.) to occupy the temporal fossa, spreading upwards to the semicircular line on the side of the skull; and its extent downwards now appears to reach to the crest on the outer aspect of the great wing of the sphenoid bone. From this extensive origin the fibres converge around a tendon, which is *inserted* into the inner surface of the coronoid process, from the apex to near the last molar tooth. Behind the posterior border of the tendon are the masseteric vessels and nerve, and in front of it the buccal vessels and nerve: the last nerve occasionally perforates some of the fibres of the muscle. Insertion of temporal muscle.

Dissection.—Separate the greater part of the temporal muscle from the subjacent bone with the handle of the scalpel, and seek the deep temporal vessels and nerves in the fibres of the muscle. A piece of the ramus of the jaw is next to be removed, but without injuring the vessels and nerves in contact with the inner surface. For this purpose, saw across the bone close to the condyle, and again close above the dental foramen on the inner surface. The handle of the scalpel may be inserted beneath the bone and carried downwards to the entrance of the foramen, to make the dental vessels and nerve secure from injury. The masseteric artery and nerve are liable to be cut in sawing the bone; should these be divided, turn them upwards for the present, and afterwards unite the ends. Take away now the loose piece of bone, and free the Dissection.

subjacent parts from cellular membrane, but be careful of the thin membrane of the internal lateral ligament which is beneath the jaw.

Position of the parts after removal of the jaw.

On the removal of the fat the pterygoid muscles will appear, the external being directed outwards to the condyle of the jaw, and the internal, which is parallel in direction to the masseter, being inclined to the angle of the jaw. Many vessels and nerves will be found in this region, with the following position to other parts. Crossing inwards over the external pterygoid muscle is the internal maxillary artery, which distributes offsets upwards and downwards; sometimes this artery will be placed beneath the muscle. Escaping from beneath the lower border of the same muscle are the large dental and gustatory nerves, the latter being the more internal of the two; and appearing between the upper border of the muscle and the cranium, are the masseteric and deep temporal nerves. The buccal branch of nerve perforates the fibres of the external pterygoid near its inner attachment. Branches of the artery accompany these nerves. At the anterior part of the space now dissected, coursing along the posterior part of the upper jaw, is the small superior dental nerve with an artery. And between the jaws is the whitish narrow band of the pterygo-maxillary ligament, to which the buccinator and superior constrictor muscles are connected.

External pterygoid is horizontal beneath the jaw.

Attachments.

The EXTERNAL PTERYGOID MUSCLE extends almost horizontally from the zygomatic fossa to the condyle of the lower jaw. Its *origin* is from the wing of the sphenoid bone, below the crest on it, and from the upper margin of the spheno-maxillary fissure; also from the outer aspect of the external pterygoid plate, and the tuberosity of the palate bone. The fibres are directed outwards and somewhat backwards, those attached to the margin of the fissure forming at first a separate bundle, and are *inserted* into the condyle and the inter-articular cartilage of the lower jaw.

Insertion.

Contiguous parts.

Externally the muscle is concealed by the temporal muscle and the lower jaw, and the internal maxillary artery lies on it. By the deep surface it is in contact with the inferior maxillary nerve, a plexus of veins, and the internal lateral ligament. The parts in contact with the borders of the muscle have been enumerated in the dissection of the region.

Internal pterygoid is

The INTERNAL PTERYGOID MUSCLE is nearly parallel to the ramus of the jaw, and its fibres are longer than those of the

preceding muscle. *Arising* from the pterygoid fossa, but chiefly from the inner aspect of the external pterygoid plate, the fibres descend to be *inserted* into the angle and part of the ramus of the jaw. On the muscle are placed the dental and gustatory nerves, the dental artery, and the internal lateral ligament. The deep surface is in connection with the superior constrictor, and at its origin with the tensor palati. beneath the ramus of the jaw; vessels and nerves around.

Before proceeding farther in the dissection, the student should examine the anatomy of the articulation of the lower jaw.

TEMPORO-MAXILLARY ARTICULATION. — In this joint the condyle of the jaw is received into the anterior hollow of the glenoid fossa of the temporal bone. The following ligaments are concerned in uniting the bones; but the bones are retained in contact chiefly by the strong muscles of the lower jaw. Joint of lower jaw.

The *external lateral* is a short, weak, ligamentous band, which is attached above to the tubercle at the bifurcation of the root of the zygoma, and below to the outer side of the neck of the inferior maxilla. External lateral and

The *internal lateral ligament* is a long, thin, membranous band, which is not in contact with the joint. Superiorly it is connected by a pointed piece to the spinous process of the sphenoid bone, and inferiorly is inserted into the orifice of the dental canal in the lower jaw. This ligament lies beneath the ramus of the jaw, between it and the internal pterygoid muscle, and its origin is concealed by the external pterygoid muscle. Between the ligament and the jaw is the internal maxillary artery. internal lateral ligament.

Besides these ligaments there are some scattered fibres surrounding the articulation, which serve the purpose of a capsular membrane. Capsule.

Dissection. — Remove the external lateral ligament and capsule of the joint, and an inter-articular cartilage, with a synovial membrane above and below it, will be exposed. Dissection.

The *inter-articular fibro-cartilage* is adapted to the surfaces of the bones. It is elongated transversely, is thinner in the centre than at the margins, and an aperture is sometimes present in the middle. The upper surface fits into the glenoid fossa, being concavo-convex from before Fibro-cartilage; its form

backwards, and the lower is moulded to the convexity of the condyle of the jaw. Externally it is connected with the external lateral ligament, and in front the external pterygoid muscle is attached to it.

and attachments.

Two synovial membranes.

Two *synovial membranes* are present in the articulation—one above, and one below the fibro-cartilage. The lower one, besides investing the surfaces of the bone and cartilage, extends from the condyle to the surface of the jaw.

Stylo-maxillary ligament.

Another structure — the *stylo-maxillary ligament* — is described as a uniting band to this articulation. This is a process of the deep cervical fascia, which extends from the styloid process to the lower part of the ramus of the jaw. The piece of fascia here referred to has been seen to separate the parotid and sub-maxillary glands, and it gives attachment to the stylo-glossus muscle.

Dissection.

Dissection.—Disarticulate the condyle of the jaw, still keeping the external pterygoid muscle attached to it, and draw both forwards; but in cutting through the ligaments be careful of the auriculo-temporal nerve close beneath. By the cautious removal of some cellular membrane the dissector will find the trunk and branches of the inferior maxillary nerve, and the small chorda tympani joining the posterior part of the gustatory nerve near the skull. The small muscular branches of the fifth nerve should be traced to the trunk in the foramen ovale of the sphenoid bone, and the auriculo-temporal nerve should be followed backwards with care behind the articulation. The middle meningeal artery ascends beneath the external pterygoid, and oftentimes the trunk of the internal maxillary artery will be found beneath that muscle. The external pterygoid muscle is to remain uncut.

Internal maxillary artery.

The INTERNAL MAXILLARY ARTERY is one of the terminal branches of the external carotid, and takes a winding course beneath the lower jaw and the temporal muscle to the spheno-maxillary fossa, where it ends in branches for the face, the interior of the nose, and the palate.

Course and connections.

At first the artery is directed inwards beneath the jaw, between the bone and the internal lateral ligament of the joint, and crosses the dental nerve. The vessel then winds over the external pterygoid muscle, being placed between it and the temporal muscle. And, lastly, the artery enters the spheno-

maxillary fossa, between the processes of origin of the external pterygoid muscle. The course of the artery may be divided into three parts: one beneath the jaw, a second between the muscles, and a third in the spheno-maxillary fossa.

Branches are three sets.

The *branches* of this artery are very numerous, and are classed into three sets, corresponding to the divisions made in the artery: thus, one set arises beneath the jaw, another beneath the temporal muscle, and another in the spheno-maxillary fossa.

Those beneath the jaw are

A. Two branches leave the internal maxillary artery, whilst it is in connection with the ramus of the jaw, viz. the inferior dental and middle meningeal.

inferior dental:

1. The *inferior dental branch* descends between the internal lateral ligament and the jaw, and entering the foramen on the inner surface of the ramus, with the dental nerve, supplies the teeth.

has a branch to mylo-hyoid muscle;

As this artery is about to enter the foramen it furnishes a small twig, *mylo-hyoid branch*, to the muscle of that name: this is conducted by a groove on the inner surface of the bone, with a branch from the dental nerve, to the superficial surface of the mylo-hyoid muscle, where it anastomoses with the submental artery.

Middle meningeal artery

2. The *middle* or *great meningeal artery* is the largest branch, and arises opposite the preceding one. It ascends beneath the external pterygoid muscle, crossing the internal lateral ligament, and enters the skull through the foramen spinosum of the sphenoid bone. When in the skull the artery ends in branches which ascend to the vertex of the head, supplying the bone and the dura mater (p. 15.). Before the meningeal artery enters the skull, it furnishes the two following small branches.

ends in skull.

but gives

branch to tympanum.

a. The *tympanic* branch enters the tympanum through the Glasserian fissure, and is distributed in that cavity, anastomosing with the other arterial branches of the part.

to meninges.

b. The *small meningeal branch* arises also near the skull and passes through the foramen ovale with the inferior maxillary nerve; it supplies the dura mater in the middle fossa of the skull.

Branches of second part are

B. The branches from the second part of the artery, viz. whilst it is between the muscles, are altogether muscular in their destination, and are named temporal, masseteric, buccal, and pterygoid.

to the temporal muscle;

1. The *deep temporal arteries* are two in number (anterior and posterior), and each occupies the part of the temporal fossa indicated

by its name. They ascend beneath the temporal muscle, and anastomose with the superficial temporal artery. The anterior also communicates, through the malar bone, with branches of the lachrymal artery.

to the masseter;

2. The *masseteric artery* is directed outwards with the nerve of the same name behind the tendon of the temporal muscle, and passing through the sigmoid notch, enters the under-surface of the masseter muscle. Its branches of distribution anastomose with the other branches to the muscle from the external carotid trunk.

to the buccinator;

3. The *buccal branch* quits the artery near the upper jaw: it then descends beneath the coronoid process with its companion nerve, and is distributed to the buccinator muscle and the side of the face, where it joins the branches of the facial artery.

to pterygoid muscles.

4. The *pterygoid branches* are uncertain in their position; they are derived either from the trunk or some of the branches of the internal maxillary, and enter the pterygoid muscles.

Branches of third part, only one now seen.

C. Of the branches that arise from the artery when it is about to enter, or has entered the spheno-maxillary fossa, only one, the superior dental, will be now described; the remainder will be examined with the superior maxillary nerve and Meckel's ganglion; they are infra-orbital, superior palatine, pterygo-palatine, spheno-palatine, and vidian.

Superior dental.

1. The *superior* or *posterior dental* branch arises near the upper maxillary bone, and descends with a tortuous course on the outer surface of that bone, along with a small branch of the superior maxillary nerve. Offsets enter the foramina in the bone, and supply the upper molar and bicuspid teeth, whilst others are furnished to the gums. Some branches reach the lining membrane of the antrum.

Internal maxillary vein begins in plexus (pterygoid),

The INTERNAL MAXILLARY VEIN receives the veins corresponding to the branches of the artery in the first two parts of its course. The different veins of this region form a plexus (*pterygoid*) between the two pterygoid muscles, and in part between the temporal and external pterygoid muscles. This plexus communicates with the facial vein by a large branch (alveolar), and with the cavernous sinus in the interior of the skull, by means of branches that pass through apertures in the base of the cranium. Escaping from the plexus, the vein accompanies the artery to the parotid gland, in which it joins the superficial temporal vein, the union of the two giving rise to the external jugular vein.

and ends in external jugular.

Peculiarities of the vessels. — The position of the internal maxillary artery is sometimes beneath, instead of over the external pterygoid muscle. In such instances the artery gains the spheno-maxillary fossa by coming forwards between the origin of the muscle that covers it. When the vessel has this unusual position some of the branches are altered with respect to the muscles; for the posterior of the two temporal branches lies over, whilst the anterior is beneath the pterygoid muscle, and the buccal branch pierces the fibres of that muscle. Internal maxillary varies in its position, and in its branches.

The INFERIOR MAXILLARY NERVE is the largest of the three trunks arising from the Gasserian ganglion of the fifth nerve, and resembles a spinal nerve in possessing fibrils with both motor and sensory power (see p. 17.). The nerve leaves the skull by the foramen ovale in the sphenoid bone, and divides into two chief parts beneath the external pterygoid muscle: an anterior, small, or muscular part; and a large, posterior, or sensory part. Inferior maxillary nerve consists of a muscular and sensory part.

A. The SMALL DIVISION receives nearly all the fibres of the motor root of the nerve, and ends in branches to the muscles of the pterygo-maxillary region, viz. temporal, masseteric, buccinator, and pterygoid. These branches are sufficiently exposed by the dissection of the arteries which they accompany; but should the internal maxillary artery obstruct the view of them, it may be taken away. Muscular division supplies four branches to

1. The *deep temporal branches* are furnished to the temporal muscle. Like the arteries, they are two in number, anterior and posterior. From their origin these nerves course upwards along the outer surface of the skull, passing first beneath the external pterygoid, and, lastly, beneath the temporal muscle. temporal muscle: two in number,

The *posterior branch* is the smallest, and is often derived from the masseteric nerve; it is near the back of the temporal fossa. posterior and

The *anterior branch* supplies the greater part of the muscle, and usually communicates with the buccal nerve. anterior.

2. The *masseteric branch* takes at first a backward direction above the external pterygoid muscle, and then a horizontal one, behind the temporal muscle and through the sigmoid notch, to the under-surface of the masseter muscle. In the masseter the nerve can be followed to near the anterior border. As this branch passes by the articulation of the jaw it gives one or more twigs to that joint. Masseter.

3. The *buccal branch* is longer than the others, and perforating the external pterygoid near its inner attachment, is directed inwards, beneath the coronoid process and the temporal muscle, to Buccinator.

the surface of the buccinator, where it ends in two terminal branches. As the nerve perforates the pterygoid muscle filaments are given to the substance; and after it has passed through the fibres, it furnishes a branch to the temporal muscle, which frequently joins the deep temporal nerve (anterior). Some offsets are likewise distributed to the upper part of the buccinator muscle and to the mucous membrane lining it.

This branch ends in two parts,

a. The *upper branch* of distribution reaches the upper part of the buccinator muscle, and communicates with the facial nerve around the facial vein.

upper and

b. The *lower branch* is in direction the continuation of the nerve. Its branches are inclined towards the angle of the mouth, supplying the integument, and the buccinator muscle and the lining mucous membrane. This branch is united freely with the facial nerve, and forms a kind of plexus.

lower.

4. The *pterygoid branches* are supplied to the muscles of that name. The branch or branches to the external pterygoid enter the under-surface, but the nerve to the internal pterygoid is placed on the pharyngeal aspect of that muscle close to the skull: this last will be given in the dissection of the otic ganglion, *Section* 14.

Branches to pterygoid muscles.

B. The LARGE BRANCH OF DIVISION of the inferior maxillary nerve ends in three large trunks, auriculo-temporal, dental, and gustatory nerves. A few of the fibres of the small (motor) root of the fifth are applied to this trunk, and are conveyed by it to certain muscles, viz. circumflexus palati, tensor tympani, and mylo-hyoideus.

Sensory trunk of inferior maxillary. Conveys a few motor fibres.

A. The AURICULO-TEMPORAL NERVE arises near the base of the skull, and oftentimes by two roots. Its course to the surface of the head is first backwards beneath the external pterygoid, as far as the inner part of the articulation of the jaw; and then upwards with the temporal artery in front of the ear, and beneath the parotid gland. In this course the nerve furnishes branches to the surrounding parts, viz. the joint, the ear, the parotid gland, and communicates also with the facial nerve. Its ramifications on the head are described at page 6. Its branches in the part now dissected are the following:—

Auriculo-temporal division lies beneath jaw, and supplies branches,

a. *Branches communicating with the facial nerve.*—Two or more branches connect the auriculo-temporal with the facial nerve, and these usually surround the external carotid artery.

to join facial;

b. Branches of the meatus auditorius and articulation.—From the point of union of the branches of the facial with the auriculo-temporal nerve, two offsets are directed to the interior of the auditory meatus, between the cartilage and the bone. The branch of nerve to the articulation of the jaw is supplied from the trunk of the auriculo-temporal near the same spot, or from the branches of it to the meatus. to the meatus and joint of jaw;

c. The *inferior auricular branch* supplies the parts of the external ear below the meatus auditorius. This branch also furnishes offsets along the internal maxillary artery, which communicate on it with the sympathetic nerve. a branch to the ear, and

d. Parotid branches.—These are small filaments that enter the substance of the gland. parotid branches.

B. The INFERIOR DENTAL NERVE is the largest of the three trunks, into which the inferior maxillary nerve divides, and it enters the canal in the lower jaw. At first the nerve lies beneath the external pterygoid muscle, where it is external in position to the gustatory; and is afterwards placed on the internal pterygoid, and near the dental foramen, on the internal lateral ligament. After the nerve enters the bone, it is continued forwards beneath the teeth to the foramen in the side of the jaw, and ends at that spot by dividing into an incisor and a labial branch. Only one other muscular branch (mylo-hyoid) is supplied by the dental nerve. Its branches are:— Inferior dental is between pterygoid muscles, and supplies teeth:

a. The *mylo-hyoid branch* arises from the trunk of the nerve as this is about to enter its foramen, and is continued along a groove on the inner aspect of the ramus of the jaw, to the cutaneous surface of the mylo-hyoideus and the anterior belly of the digastric muscle. also branch to mylo-hyoideus.

b. The *dental branches* arise in the bone and supply the fangs of the molar and bicuspid teeth. If the bone is soft, the canal containing the nerve and artery may be laid open so as to expose these branches. Dental branches to grinding

c. The *incisor branch* continues the trunk of the nerve onwards to the middle line, and furnishes offsets to the canine and incisor teeth, beneath which it lies. and cutting teeth.

d. The *labial branch* (mental?) issues on the face beneath the depressor of the angle of the mouth. At first it communicates with the facial nerve, and gives branches to the muscle that covers it, also to the orbicularis and the integuments. But the greater part of the nerve is directed upwards, beneath the depressor labii Branch of lower lip.

inferioris, and is distributed on the inner and outer surfaces of the lower lip.

Dental artery

The *inferior dental artery*, after entering the lower jaw with the nerve, has the same course and distribution. Thus it supplies dental branches to the molar and bicuspid teeth, and ends anteriorly in an incisor and a labial branch.

has an incisor and

The *incisor branch* is continued to the symphysis of the jaw, beneath the canine and incisor teeth, which it supplies, and anastomoses with the artery of the opposite side.

labial branch.

b. The *labial branch*, after it has left the bone, ramifies in the structures covering the lower jaw, and communicates with the branches of the facial artery.

Gustatory nerve courses to tongue;

C. The GUSTATORY OR LINGUAL NERVE is the remaining part of the inferior maxillary, and is concealed at first, like the others, by the external pterygoid muscle. It is then directed inwards over the internal pterygoid muscle, and under cover of the side of the jaw to the tongue. The remainder of this nerve will be seen in the dissection of the submaxillary region.

no branch here,

In this extent of the nerve there is not any branch of distribution, but a communicating branch (chorda tympani) is received by it.

but is joined by chorda tympani.

The *chorda tympani* is a branch of the facial nerve which crosses the tympanum, and leaves the cavity by an aperture near the Glasserian fissure. This small nerve is then inclined forwards to join the gustatory nerve at an acute angle, beneath the external pterygoid muscle. From the point of junction some fibres are prolonged on the gustatory to the submaxillary ganglion.

SECTION VII.

SUBMAXILLARY REGION.

Parts occupying the region.

THE part to which the term submaxillary region is applied, is placed between the jaw and the hyoid bone. In it will be found the small muscles between the os hyoides and the jaw and tongue, the vessels and nerves of the tongue, and the sublingual and submaxillary glands.

Dissection.

Dissection.—In this dissection the position of the neck is the same as for the examination of the anterior triangle. The parts

should have been cleaned with the triangular space; but if any cellular membrane is left on the submaxillary gland, or the mylo-hyoid muscle, let it be taken away.

The *submaxillary gland* lies below the jaw in the anterior part of the space limited by it and the digastric muscle. Its shape is irregular, and the facial artery winds over the surface. The gland rests on the mylo-hyoid muscle, and sends a process round the posterior or free border. In front of it is the anterior belly of the digastric, and behind it is the stylo-maxillary ligament, separating it from the parotid. Occupying this position, somewhat beneath the side of the jaw, the gland is very near the surface, being covered only by the integuments and platysma, and by the deep fascia. Situation and connections of submaxillary gland.

In structure, the submaxillary resembles the parotid gland, and its duct (duct of Wharton) extends beneath the mylo-hyoid muscle to the mouth.

Dissection.—To expose the mylo-hyoid muscle, detach the anterior belly of the digastric from the jaw and throw it downwards; dislodge also the submaxillary gland from its position under the jaw. Dissection.

The MYLO-HYOID MUSCLE is triangular in shape, with the base at the jaw and the apex at the hyoid bone, and unites along the middle line with its fellow of the opposite side. It *arises* from the ridge (mylo-hyoid) on the inner surface of the jaw, and is *inserted* into the body of the hyoid bone, as well as into a central line between the jaw and that bone. On the cutaneous surface are the digastric muscle, the submaxillary gland, the facial artery with its submental branch, and the branch of nerve and artery to the muscle. Its fibres are frequently deficient near the jaw, and allow the next muscle to appear. Only the posterior border is unattached, and round it turns a piece of the submaxillary gland. The parts in contact with the deep surface of the muscle will be perceived after the following dissection has been made:— Mylo-hyoideus arises from jaw; inserted into hyoid bone. Parts around it.

Dissection.—The student is now to expose the deep muscles, and to trace the vessels and nerves to the substance of the tongue. For this purpose cut through the facial vessels on the jaw, and remove them with a superficial part of the submaxillary gland, but be careful to leave the deep part of the gland that turns beneath Dissection, to detach mylo-hyoid.

the mylo-hyoideus. Detach the mylo-hyoid from the jaw and from its fellow, and cut through the small branch of artery and nerve on its surface; then throw down the muscle to the os hyoides, but without injuring the genio-hyoid muscle beneath it.

To see deep muscles

Next the lower jaw is to be sawn through rather on the right side of its symphysis, after the soft parts covering it are divided. The side of the jaw, which will then be loose, for the ramus of the bone has been previously cut, is neither to be taken away, nor to be separated from the mucous membrane of the mouth. To enable the dissector to raise upwards this detached piece of bone, seize the apex of the tongue, draw it well out of the mouth over the upper teeth, and fasten it in that position with a stitch; then sink the scalpel between the cut surfaces of the bone to divide a strong band of the mucous membrane of the mouth, and carry the knife onwards along the middle line of the tongue to its tip. The detached piece of the jaw can now be easily turned upwards, and it is to be fastened in that position with a stitch.

and nerves.

By means of a hook, the os hyoides may be drawn down, and the muscular fibres made tense. Remove now the cellular membrane, taking care of the Whartonian duct, and of the hypo-glossal nerve and its branches, that lie on the hyo-glossus muscle; also of the gustatory nerve nearer the jaw, with its small ganglion close to the submaxillary gland. The ranine vessels and the gustatory nerve should also be traced along the under part of the tongue.

Parts beneath mylo-hyoid

on side of neck,

The following is the position of the parts brought into view after the removal of the mylo-hyoid muscle. Extending from the cornu of the hyoid bone to the side of the tongue is the hyo-glossus muscle, whose fibres are crossed superiorly by those of the stylo-glossus. On the hyo-glossus, from below upwards, are placed the hypo-glossal nerve, the Whartonian duct, and the gustatory nerve, the latter crossing the duct; and near the inner border of that muscle the two nerves are united by branches. Beneath the same muscle is the lingual artery with its vein. Above the hyo-glossus is the mucous membrane of the mouth, with the sublingual gland attached to it in front, and some fibres of the superior constrictor muscle covering it behind near the jaw.

and along middle line.

Between the chin and the os hyoides, along the middle line, is the genio-hyoid muscle; and larger and deeper than this is a fan-shaped muscle, the genio-hyo-glossus. Along the outer side of the last muscle lie the ranine vessels; and a sub-

lingual branch of the gland springs from the lingual artery. On the under aspect of the tongue, near the margin, is the gustatory nerve; and in the fibres of the genio-hyo-glossus, the hypo-glossal nerve.

The HYO-GLOSSUS MUSCLE is thin and somewhat of a square shape. The muscle *arises* from the body and cornua of the os hyoides, and is *inserted* into the side of the tongue, its fibres mingling with those of the stylo-glossus and lingualis. The parts in contact with one aspect of the hyo-glossus have been already enumerated; and those beneath the muscle are part of the genio-hyo-glossus and the superior constrictor, with the lingual artery. Along the anterior border is the genio-hyo-glossus muscle, and beneath the posterior pass the lingual artery, the glosso-pharyngeal nerve, and the stylo-hyoid ligament.

Hyo-glossus is named from attachment; is in contact with many parts.

The STYLO-GLOSSUS is a slender muscle, whose attachments are expressed by its name. Arising from the styloid process near the apex, and from the stylo-maxillary ligament, the muscle is *inserted* into the side of the tongue with the preceding, and also sends forwards a band of fibres to the tip of that body. This muscle lies between the carotid arteries, and below the jaw it is crossed by the gustatory nerve.

Stylo-glossus comes to side of tongue.

The GENIO-HYOID MUSCLE *arises* from the lower of the two tubercles on the inner aspect of the symphysis of the jaw, and is *inserted* into the middle part of the hyoid bone. Covered by the mylo-hyoideus, this muscle rests on the genio-hyo-glossus. The inner border is close to its fellow of the opposite side, and the two are often united.

Genio-hyoideus is along middle line of neck.

The GENIO-HYO-GLOSSUS is the largest muscle of this region, and is in contact along the middle line with the corresponding muscle of the other side. It takes *origin* from the upper tubercle behind the symphysis of the jaw. From this spot the fibres radiate to their insertion into the hyoid bone (the small cornu), and the whole length of the tongue, from root to point. Lying along the middle of the tongue, and in contact with its fellow, except near the os hyoides where a small interval exists, the lower border of the muscle corresponds to the genio-hyoideus, and the upper to the frænum linguæ. On its outer side are the ranine vessels and

Genio-hyo-glossus is connected with chin, hyoid bone, and tongue.

Contiguous parts.

the hyo-glossus muscle, and the ninth nerve perforates the posterior fibres.

Lingual artery

The *lingual artery* is one of the anterior branches of the external carotid, and arises between the superior thyroid and facial branches. At first it is directed inwards above the os hyoides, but is afterwards inclined slightly upwards beneath the hyo-glossus to the under part of the tongue, and ends at the anterior border of that muscle, in the sublingual and ranine branches. Before reaching the hyo-glossus, the artery is superficial, though it is crossed near that muscle by the ninth nerve, and by the digastric and stylo-hyoid muscles. Beneath the hyo-glossus, the vessel rests on the superior constrictor and genio-hyo-glossus muscles, and is situate below the level of the glosso-pharyngeal nerve. Its *branches* are these :—

ascends to the tongue beneath hyo-glossus.

Its branches are—

to hyoid bone ;

A small *hyoid branch* is distributed along the upper border of the os hyoides, anastomosing with the one of the opposite side, and with the hyoid branch of the superior thyroid artery.

to back of tongue ;

A *branch to the dorsum of the tongue* arises beneath the hyo-glossus muscle, and ascends to supply the substance of that organ. The fibres of the muscle must be divided to see it.

to the sublingual gland.

The *sublingual branch* springs from the final division of the artery at the edge of the hyo-glossus, and is then directed outwards to the gland from which it takes its name. Some branches also supply the gums and the mylo-hyoid muscle, and one offset continues behind the incisor teeth to join a similar artery from the other side.

to the substance of tongue.

The *ranine branch* is the terminal part of the lingual artery, and extends forwards along the outer side of the genio-hyo-glossus to the tip of the tongue, where it ends by anastomosing with the artery of the other side of the body. Muscular offsets are furnished to the substance of the tongue. This artery corresponds to the frænum linguæ, near the tip of the tongue, but is close to the muscular fibres.

This lies along frænum.

Lingual vein.

The *lingual vein* commences both on the upper and under surfaces of the tongue. It accompanies the artery of the same name, and ends in the internal jugular vein.

Lingual nerve

The GUSTATORY OR LINGUAL NERVE has been followed in the pterygo-maxillary region to its passage between the ramus of the lower jaw and the internal pterygoid muscle. In this dissection the nerve is seen to be inclined forwards to the side of the tongue over the mucous membrane of the

along side of tongue

mouth and the origin of the superior constrictor muscle, and above the deep part of the submaxillary gland. Lastly, the nerve is directed along the side of the tongue to the apex across the Whartonian duct. In this region the gustatory nerve is separated altogether from the cavity of the mouth by the layer of mucous membrane. *Branches* are furnished to the surrounding parts, thus:— gives these branches

Two or more branches connect it with the submaxillary ganglion, near the gland of that name. to the ganglion,

Farther forwards branches descend on the hyo-glossus to unite in a kind of plexus with twigs of the hypo-glossal nerve. to join ninth nerve,

Other filaments are supplied to the mucous membrane of the mouth, the gums, and the sublingual gland. to mucous membrane,

Lastly the *branches of the tongue* ascend through the muscular substance, and are distributed to the conical and fungiform papillæ. to the papillæ.

Submaxillary ganglion.—Closely connected with the gustatory nerve is this little ganglion, which resembles the other ganglia in communication with the three trunks of the fifth nerve, in the fact of having filaments of union with sensory, motory, and sympathetic nerves. It is a small reddish body, about the size of the lenticular ganglion, and is placed above the deep process of the submaxillary gland. From the upper part offsets proceed to connect it with other nerves, and from the lower part the branches of distribution arise. Submaxillary ganglion contains three sets of fibrils, which unite it

Connection with nerves — roots. — Two or three branches, in the form of loops, pass from the ganglion to the gustatory nerve. At the posterior part, the ganglion is further joined by the chorda tympani (of the facial nerve), which is prolonged to it in contact with the gustatory. And its sympathetic branch comes from the nerves around the facial artery. with gustatory, facial, and sympathetic nerves.

Branches of distribution. — From the lower part of the ganglion five or six branches descend to the substance of the submaxillary gland; and from the anterior part other large filaments are furnished to the mucous membrane of the mouth and to the Whartonian duct. Branches to gland and mucous membrane.

The HYPO-GLOSSAL OR NINTH NERVE, after crossing the side of the neck and the anterior triangle (p. 73.), enters between the small muscles of the submaxillary region. Here the nerve lies on the hyo-glossus muscle, being concealed by the mylo-hyoideus; but at the inner border of the hyo-glossus Ninth nerve, between the chin and hyoid bone

it enters the fibres of the genio-hyo-glossus, and is continued along the middle line of the tongue to the apex. The position of the ninth nerve is in the centre of the tongue, whilst the gustatory lies near the margin; the ninth supplies branches to the muscular structure, and the gustatory ends chiefly in the papillæ.

is lost in middle of tongue.

Branches.—On the hyo-glossus the ninth nerve furnishes branches to the muscles of the submaxillary region, except the mylo-hyoid, viz. to the hyo-glossus, stylo-glossus, genio-hyoideus, and genio-hyo-glossus. Further, some offsets ascend on the hyo-glossus to communicate with the gustatory nerve. Along the middle of the tongue the nerve sends upwards long filaments with the branches of the ranine artery, that supply the structure of the tongue, and communicate with the gustatory nerve.

Its branches supply muscles and the tongue.

Wharton's duct opens by frænum linguæ. Structure.

The *duct of the submaxillary gland*, or Wharton's duct, issues from the deep part of the glandular mass that turns round the border of the mylo-hyoid muscle. It is about two inches in length, and is directed upwards on the hyo-glossus muscle, and beneath the gustatory nerve, to open on the side of the frænum linguæ, in the centre of an eminence. The duct consists of a thin, fibrous, and a mucous coat, and its opening in the mouth will be seen if a bristle is passed along it. The deep part of the submaxillary gland extends, in some instances, even to the sublingual gland.

Sublingual gland is beneath tongue.

The *sublingual gland* is somewhat of the shape of an almond, and the longest measurement, which is about one inch and a half, is directed backwards. It is situate beneath the anterior part of the tongue, in contact with the inner surface of the lower jaw, close to the symphysis. Separated from the cavity of the mouth by the mucous membrane, the gland is prolonged across the upper border of the genio-hyo-glossus muscle, so as to touch the one of the opposite side.

Structure. Ducts open in mouth.

The sublingual resembles the other salivary glands in its composition. The ducts of the lobules (ductus Riviniani) are from eight to twenty in number, of which some open beneath the tongue along a crescentic shaped fold of the mucous membrane; but others join the Whartonian duct, and one or more form a larger tube, that either joins that duct or opens near it.

Section VIII.

SUPERIOR MAXILLARY NERVE AND VESSELS.

The remaining trunk of the fifth nerve, viz. superior maxillary, is now seen most conveniently after the dissection of the pterygo-maxillary and sub-maxillary regions. Superior maxillary nerve next.

Dissection.—The superior maxillary division of the fifth nerve, in its course to the face, is placed in the skull, in the spheno-maxillary fossa, and below the orbit; and to expose the nerve, it will be necessary to open the skull, fossa, and orbit. The orbit is supposed to be opened; but if it is not, see the dissection necessary for that step. To trace the nerve in the other two parts, make the following dissection:—with a chisel, cut from the inside along the middle fossa of the base of the skull, as far back as the foramen spinosum, and then saw through the side of the skull to meet the end of that cut. Afterwards, with a bone forceps, divide the outer wall of the orbit into the spheno-maxillary fissure. The piece of bone forming part of the skull and orbit is now loose, and is to be removed with the temporal muscle. The nerve is partly seen as it crosses the spheno-maxillary fossa; but to bring it more completely into view, take away some of the sphenoid bone bounding the fossa, leaving only an osseous ring around the nerve at its exit from the skull. In the fat of the fossa the nerve gives off the orbital branch, branches to Meckel's ganglion, and dental branches. Trace onwards the nerve in the floor of the orbit, and follow it through the infra-orbital foramen to the face. Near the front of the orbit the anterior dental branch is to be traced downwards for some distance in the bone. Dissection.

The SUPERIOR MAXILLARY NERVE commences in the Gasserian ganglion (p. 17.), and leaves the cranium by the foramen rotundum. The course of the nerve is then almost straight to the face, along the orbital aspect of the superior maxilla. Outside the cranium the nerve is first placed across the spheno-maxillary fossa, and it afterwards enters the infra-orbital canal. Issuing from the canal by the infra-orbital foramen, the nerve is concealed by the elevator of the upper lip, and ends in branches to the eyelid, nose, and upper lip. It furnishes the following branches:— Upper maxillary nerve passes to face, through infra-orbital canal, where it ends.

Its branches are to orbit, 1. The *orbital branch* arises in the spheno-maxillary fossa, and enters the orbit through the fissure of the same name; it divides into a malar and a temporal branch (see p. 47.).

to the nose and palate, 2. The *spheno-palatine branches* descend also from the nerve in the fossa, and supply the nose and palate: these are connected with Meckel's ganglion, and will be dissected with it.

to the posterior teeth, and buccinator, 3. Two *posterior dental branches* leave the trunk of the nerve near the upper jaw. One is distributed to the buccinator muscle and the gums. The other enters a canal in the upper maxilla, and supplies branches to the molar teeth and the lining membrane of the antrum; it joins the anterior dental branch soon after entering the bone, and again near the teeth.

to anterior teeth. 4. The *anterior dental branch* quits the trunk of the nerve in the floor of the orbit, and descends to the anterior teeth in a special canal in front of the antrum. It is distributed by two branches. One (the inner) gives filaments to the incisor and canine teeth, and furnishes, moreover, one or two filaments to the lower meatus of the nose; the other (outer) ends by supplying the bicuspid teeth.

Infra-orbital branches join facial nerve, and supply side of nose 5. *Infra-orbital or facial branches.* — These are larger than the other offsets of the nerve, and form its terminal ramifications. Some incline inwards to the side of the nose, and the rest descend to the upper lip. These branches are crossed near the orbit by branches of the facial nerve, with which they communicate, the union forming the *infra-orbital plexus* (p. 37.).

a. The *branches to the side of the nose* supply the muscular and tegumentary structures and join the nasal nerve.

and upper lip. *b.* The *branches to the upper lip* are three or four in number, and are distributed chiefly to the surfaces of the lip, though they supply also the labial glands and the muscles.

Branch of eyelid. 6. Before the nerve ends in the facial branches, it supplies a small *palpebral branch* to the lower eyelid; this is directed upwards to the lid in a groove in the margin of the orbit.

Infra-orbital artery The *infra-orbital* is one of the terminal branches of the internal maxillary artery in the spheno-maxillary fossa, and accompanies the superior maxillary nerve. Taking the course of the nerve through the infra-orbital canal, the artery appears in the face beneath the elevator muscle of the upper lip, and ends in branches, which are distributed, like the nerve, to the part of the face between the eye and the mouth. In the face, its branches anastomose with the facial and buccal arteries.

ends in face;

has a branch to orbit, In the canal in the upper maxilla this artery furnishes branches to the orbit.

and one Another branch, *anterior dental*, runs with the nerve of the same name,

and supplies the incisor and canine teeth. This gives branches to the antrum of the maxilla, and near the teeth it anastomoses with the posterior dental artery. to anterior teeth.

The *vein*, along with the artery, communicates with the facial vein by means of the large alveolar branch; for the last springs from the veins corresponding to the branches of the internal maxillary artery in the spheno-maxillary fossa. Infra-orbital vein.

SECTION IX.

DEEP VESSELS AND NERVES OF THE NECK.

THE position of the part is still the same, viz. the neck is to be fixed over a small block. In this section are included the deep styloid muscle, the internal carotid and ascending pharyngeal arteries, with the eighth, ninth, and sympathetic nerves. Vessels and nerves in this section.

Dissection.—To expose the remaining styloid muscle, detach the posterior belly of the digastric and the stylo-hyoid muscle from their origin, and throw both down. Let the student observe, at the same time, the filament of the facial nerve perforating the digastric muscle, and joining the glosso-pharyngeal nerve. Remove the trunk of the external carotid artery by cutting it through where the hypo-glossal nerve crosses it, and dividing those branches that have been already examined. The veins accompanying the artery may also be taken away, if it is necessary. Clean then the surface of the stylo-pharyngeus muscle and the glosso-pharyngeal nerve in contact with it. The side of the jaw is still to remain turned upwards, as in the dissection of the submaxillary region. Dissection.

The STYLO-PHARYNGEUS MUSCLE resembles the other styloid muscles in its elongated form. The fibres *arise* from the root of the styloid process on its inner surface, and descend between the superior and middle constrictors to be *inserted* partly into the pharynx and partly into the posterior border of the thyroid cartilage. The muscle lies below the stylo-glossus, between the carotid arteries, and the glosso pharyngeal nerve turns over the lower part of the fleshy belly. Stylo-pharyngeus. Origin. Insertion. Is between carotid arteries.

The *stylo-hyoid ligament* is a fibrous band that extends from the tip of the styloid process to the small cornu of the Stylo-hyoid ligament

lies by side of preceding. os hyoides. Its position is between the stylo-glossus and stylo-pharyngeus muscles, and over the internal carotid artery. The lower end is beneath the hyo-glossus muscle; and to the posterior border the middle constrictor muscle is attached. It is frequently cartilaginous or osseous in part of, or in all its extent.

Dissection of carotid in the neck; *Dissection of the internal carotid.*—Detach the styloid process at its root, and throw it to the middle line with the attached muscles. Follow upwards to the skull the internal carotid artery and jugular vein, and clean away the dense fascia that conceals them; but let this be done carefully, so as not to injure the branches of the eighth and ninth nerves, that are found in contact with the vessels near the base of the skull. In the fascia, and superficial to the artery, are the pharyngeal branch of the vagus (near the skull), and the glosso-pharyngeal nerve and its branches, whilst the superior laryngeal branch of the vagus is beneath the artery. Between the vein and artery, near the skull, are the vagus and hypo-glossal nerves; and crossing backwards, over or under the vein, the spinal accessory nerve. External to the position of the vessels will be found a loop of the first and second cervical nerves over the transverse process of the atlas, which communicates with the large ganglion of the sympathetic beneath the artery, and with the eighth and ninth nerves. Ascending to the cranium, on the inner side of the carotid, is the ascending pharyngeal artery.

in the temporal bone. To open the carotid canal in the temporal bone, and to follow the contained artery into the cranium, make the following cut down the side of the skull:—place the saw behind the mastoid process, and cut forwards to the foramen spinosum in the wing of the sphenoid bone (to which spot the side of the skull has been already taken away), the saw being directed through the stylo-mastoid foramen, the root of the styloid process, and external to the jugular foramen and the carotid canal. When the piece of detached bone is taken away, open the carotid canal with the bone forceps. In dissecting the artery in the canal, large reddish branches of the superior cervical ganglion of the sympathetic will be found on it; and with care two small filaments may be found, one from Jacobson's nerve, joining the sympathetic at the posterior part of the canal; the other from the vidian nerve, at the front of the canal.

Piece of tympanum exposed. On the piece of bone that is cut off, the dissector may expose very readily the tympanum with its membrane, chain of bones, and chorda tympani nerve.

The INTERNAL CAROTID ARTERY supplies the parts within the head, viz. the brain and the orbit, and takes its name from its distribution. Springing from the bifurcation of the common carotid trunk, this artery extends from the upper border of the thyroid cartilage to the base of the skull, then through the petrous portion of the temporal bone, and lastly along the base of the skull to the anterior clinoid process, where it ends in branches for the brain. This winding course of the artery may be divided into three parts:— one part in the neck, another inside the skull, and a third in the temporal bone.

Internal carotid enters the skull.

Its course is first

Cervical part.—In the neck the artery ascends almost vertically from its origin to the carotid canal, and is in contact with the pharynx on its inner side. Its depth from the surface varies like the external carotid; and the line of the digastric muscle may be taken as the index of this difference. Thus, below that muscle the internal carotid is superficial in the anterior triangular space, being covered only by the common teguments, fascia, and platysma; and is on the same level as the external carotid, though outside it. But above that muscle the vessel is placed deeply beneath the external carotid artery and the parotid gland, and is crossed by the stylo-glossus and stylo-pharyngeus muscles with the stylo-hyoid ligament, by the glosso-pharyngeal nerve and its branches, and by the pharyngeal branch of the vagus nerve. Whilst in the neck the internal carotid lies on the rectus capitis anticus major muscle, which separates it from the vertebræ, also on the superior laryngeal and sympathetic nerves. Accompanying the artery is the internal jugular vein, which is placed on the outer side, and between these two vessels is the pneumo-gastric nerve. This part of the artery remains much the same size to the end, and usually does not furnish any branch.

in the neck, where it is superficial below but deep above; resting on longus colli, with internal jugular vein and vagus.

Part in the temporal bone.—In the carotid canal the tortuous course of the vessel commences. Following the winding of its canal, the artery first ascends in front of the cochlea and tympanum; next it is directed forwards almost horizontally, and lastly turns upwards into the skull opposite

Second part in temporal bone.

Surrounded by sympathetic.

the foramen lacerum medium basis cranii. The ascending branches of the sympathetic nerve surround the carotid artery in the temporal bone.

Third part.

The *cranial part* of the artery is described with the base of the skull (see p. 19.).

Internal jugular vein joins inferiorly subclavian.

The INTERNAL JUGULAR VEIN is a continuation of the lateral sinus of the skull, and extends from the foramen lacerum jugulare to the sterno-clavicular articulation. At the lower part of the neck it has been seen to join the subclavian, to form the innominal vein (p. 67.). As far as the thyroid cartilage this vein accompanies the internal carotid, but below that point the common carotid artery, and is placed on the outer side of both. Its position to the artery is not equally close in all its extent, for near the skull there is a small interval between them, containing the eighth and ninth nerves, and at the lower part of the neck there is a still larger intervening space, in which is found the pneumogastric nerve. The size of the vein remains much the same till near the os hyoides, where it is suddenly increased by the addition of those branches of the head and neck, corresponding to the branches of the external carotid artery, that do not join the external jugular vein. The following branches open into the internal jugular, viz. the facial, lingual, thyroid (superior), occipital, and pharyngeal; and at the lower part of the neck it receives the middle thyroid vein.

Is on outside of carotids, and is joined by branches below os hyoides.

Peculiarities in length, direction, and origin of the carotid.

Peculiarities in the carotid.— The length of the internal carotid vessel varies in a given number of bodies, both from difference in the length of the neck, and in the point of division of the common carotid trunk. The direction of the vessel may be very tortuous instead of being straight. It has been already said (p. 59.) that the internal carotid may arise from the arch of the aorta; and further, the vessel may be absent from the neck.—(*Quain.*)

Ascending pharyngeal artery

The *ascending pharyngeal artery* is a long slender branch of the external carotid, which arises near the commencement of that vessel. Directed upwards on the spinal column, between the internal carotid and the pharynx, the artery becomes tortuous near the skull, and divides into branches for the pharynx and the cranium.

ends

In the neck the artery gives small branches to the surrounding

parts, viz. the muscles on the vertebræ, the nerves, and the lymphatic glands; and other branches anastomose with the ascending cervical artery. near skull, in

The *meningeal branch* enters the cranium through the foramen lacerum medium basis cranii, and is distributed to the meninges of the middle fossa of the skull. a branch to meninges,

The *pharyngeal branch*, which is larger than the preceding, turns inwards to the pharynx, and dividing into several twigs, supplies the muscular structure of the pharynx, the soft palate, and the Eustachian tube. The size of this branch depends upon that of the inferior palatine branch of the facial artery. and another to pharynx and palate.

The *vein* corresponding to the pharyngeal artery receives branches from the cranium and the pharynx, and ends in the internal jugular vein. Its vein.

Dissection of the eighth nerve.—By the time the student has arrived at this stage of the dissection, it generally is not possible for him to trace the very minute filaments of the eighth nerve in the foramen lacerum of the skull. The dissector is therefore recommended to omit, for the present, all the paragraphs marked with an asterisk. Afterwards, if a fresh piece of the skull can be obtained, in which the nerves have been hardened by spirit, and the bone softened by acid, the dissector may return to the examination of the parts he now passes over. Directions concerning eighth nerve.

* *In the foramen lacerum.*—Supposing the dissection of the internal carotid to be made as it is described at page 98., let the student cut across with care the jugular vein near the skull, and the internal carotid, if it is necessary. Let him then remove, bit by bit, with the bone forceps, the ring of bone that bounds externally the jugular foramen, proceeding as far forwards as the crest of bone between the foramen and the aperture of the carotid canal. Between the ring of bone and the coat of the jugular vein is the small auricular branch of the pneumo-gastric nerve, which is directed backwards to a foramen near the styloid process. Dissection to open foramen lacerum.

* First trace the pneumo-gastric and spinal accessory nerves through the canal by opening the fibrous sheath that surrounds them. On the pneumo-gastric is a small ganglion, from which filaments are to be sought passing to the spinal accessory nerve, and to the ascending branch of the upper cervical ganglion of the sympathetic; the auricular branch, before referred to, also takes origin from this ganglion. Follow pneumo-gastric and spinal accessory and their branches;

afterwards, glosso-pharyngeal

* Now follow the glosso-pharyngeal nerve through the foramen, and break away any bone that overhangs it. This nerve presents two ganglia as it passes from the skull: one (jugular) near the upper part of the tube of membrane that contains it, the other much larger (petrous) is placed at the lower border of the petrous portion of the temporal bone. From the lower one seek a filament of communication with the sympathetic in the neck; also Jacobson's nerve, that enters an aperture in, or on one side of the crest of bone between the jugular foramen and carotid canal. Sometimes there will exist a filament of the lower ganglion to join the auricular branch of the pneumo-gastric, and another to the upper ganglion of the pneumo-gastric nerve.

and its branches.

Dissection of the nerves in the neck.

Below the foramen of exit from the skull, the eighth nerve is sufficiently exposed by the dissection of the internal carotid to examine its branches in the neck, with the exception of the inferior laryngeal nerve. But the connections between the eighth, ninth, sympathetic, and first two spinal nerves should be traced out near the skull. Taking the pneumo-gastric nerve, it will be found to swell into a large oval body (lower ganglion), which is closely united with the ninth nerve, and is connected by branches with the other nerves. The spinal accessory nerve will likewise be found to give a communicating offset to the pneumo-gastric nerve, close to the skull. The ninth nerve communicates also with the sympathetic and spinal nerves. Lastly, the student should trace the recurrent branch from the lower part of the neck to the larynx.

Eighth nerve

The EIGHTH CRANIAL NERVE consists of three distinct trunks, viz. glosso-pharyngeal, pneumo-gastric, and spinal accessory, which leave the cranium by the foramen lacerum jugulare (p. 18.). Outside the skull these nerves take different directions according to their destination; thus the glosso-pharyngeal is inclined inwards to the tongue and pharynx; the spinal accessory passes backwards to the sterno-mastoid and trapezius muscles; and the pneumo-gastric nerve descends to the thorax and the abdomen.

consists of the three following trunks:

Glosso-pharyngeal nerve;

A. The GLOSSO-PHARYNGEAL NERVE is the smallest of the three trunks, and in the jugular foramen is somewhat in front of the other two; it lies in a groove in the lower border of the petrous part of the temporal bone. In the aperture of exit, the nerve is marked by two ganglionic swellings, the upper one being the jugular, and the lower one the petrous ganglion.

has two ganglia in foramen lacerum

After the nerve has quitted the foramen it comes forwards between the jugular vein and carotid artery, and crossing inwards over the artery, reaches the lower border of the stylo-pharyngeus muscle. At this spot the course of the nerve becomes almost transverse in its direction to the pharynx, lying over the stylo-pharyngeus, and forming an arch across the side of the neck, above the superior laryngeal nerve. Finally the nerve enters beneath the hyo-glossus muscle, and ends in branches to the pharynx, the tongue, and the tonsil.

In the neck, courses to the tongue and pharynx.

Ganglia.—The *jugular ganglion* (gang. superius) is of very small size, and is situate at the upper part of the osseous groove that contains the nerve. It occupies the outer part of the glosso-pharyngeal trunk, and includes only some fibres of the nerve. The *petrosal ganglion* (gang. inferius) is much larger than the preceding, and encloses all the fibrils of the nerve. This ganglion is placed in a hollow in the lower border of the temporal bone, and from it arise the branches that unite the glosso-pharyngeal with the other nerves.

Its upper and lower ganglion.

The *branches* of the glosso-pharyngeal are classed into those connecting it with other nerves at the base of the skull, and those that are distributed in the neck.

Branches

CONNECTING BRANCHES.—These arise chiefly from the petrosal ganglion, and in this set is the tympanic nerve.

uniting it with others, viz.

1. * A *filament* ascends from the *sympathetic nerve* in the neck to join the petrosal ganglion ; and sometimes there is a filament given from this ganglion to the auricular branch of the vagus, as well as to the upper ganglion of that nerve.

sympathetic and vagus,

2. * The *tympanic branch* (nerve of Jacobson) enters the aperture in the ridge of bone situate between the jugular and the carotid foramen, and ascends by a special canal to the inner wall of the tympanum, where it ends in branches. Its distribution is given with the anatomy of the ear.

facial and sympathetic,

3. *Connecting branch of the facial nerve.*— This pierces the digastric muscle, and joins the trunk of the glosso-pharyngeal, below the petrosal ganglion.

and with facial ;

BRANCHES OF DISTRIBUTION.— In the neck the branches are furnished chiefly to the tongue and the pharynx, but they are also united with other nerves.

and distributed to

1. *Carotid branches* surround the artery of that name, and com-

carotid artery,

municate on it with the pharyngeal branch of the vagus and with the sympathetic nerve.

stylo-pharyngeus,

2. Some *muscular branches* enter the stylo-pharyngeus whilst the nerve is in contact with it.

pharynx, and pharyngeal plexus,

3. *Branches to the pharynx* form the pharyngeal plexus by uniting with nerves from the sympathetic and vagus. This plexus is opposite the middle constrictor, and branches are furnished by it to the muscles and the mucous membrane of the pharynx, between the tongue and the hyoid bone.

the tonsil,

4. The *tonsillitic branches* supply the tonsil and the soft palate. On the former they form a kind of plexus (circulus tonsillaris).

and the tongue.

5. *Lingual branches.*—The terminal branches of the nerve supply the root, and the surface of the posterior part of the tongue. The distribution of these is described with the tongue.

Vagus nerve in foramen lacerum,

B. The PNEUMO-GASTRIC NERVE (vagus nerve) is the largest of the three trunks of the eighth cranial nerve, and occupies the same sheath of dura mater as the spinal accessory. In the foramen it has a distinct ganglion (gang. of the root), to which the spinal accessory nerve is united.

and in the neck, coursing to the thorax.

When the nerve has escaped from the foramen, it receives a branch from the spinal accessory, and swells into a large ganglion (gang. of the trunk). Here the nerve lies between the carotid artery and the jugular vein, and communicates with the several nerves at this part. To reach the thorax the vagus descends almost vertically between the internal jugular vein and the internal and common carotid arteries, and enters that cavity on the right side, by crossing over the subclavian artery.

One ganglion in foramen, another below.

Ganglia.—The *ganglion of the root* (gang. superius) is of a greyish colour, and in texture is like the ganglion on the posterior root of the spinal nerves. The small branches of the vagus in the foramen lacerum come from this ganglion. The *ganglion of the trunk* (gang. inferius) is cylindrical in form, is reddish in colour, and is nearly an inch in length. It communicates with the hypo-glossal, spinal, and sympathetic nerves. All the fibres of the trunk of the nerve are not surrounded by the ganglionic substance, for those derived from the spinal accessory nerve pass by the ganglion without being inclosed in it.

Branches

The same arrangement may be made of the *branches* of the pneumo-gastric in the neck, as was adopted for the

branches of the glosso-pharyngeal, viz. into those uniting it with other nerves and those that are distributed to parts.

CONNECTING BRANCHES. — Branches of communication arise both from the ganglion of the root and that of the trunk of the nerve. to unite with others;

* *a. From the ganglion of the root.* — One or two short filaments unite this ganglion with the spinal accessory nerve. Another filament of the sympathetic nerve in the neck enters the ganglion; and occasionally there is a filament to join the lower (petrosal) ganglion of the glosso-pharyngeal nerve. viz. spinal accessory, sympathetic, and glosso-pharyngeal;

* The *auricular branch* traverses the substance of the temporal bone, communicating in it with the facial nerve, and reaches the outer ear, on which it is distributed. This little nerve arises from the ganglion, and crosses the jugular fossa to enter an aperture near the root of the styloid process. Its farther course to the outer ear will be described with the anatomy of the ear. with facial by auricular branch;

* *b. From the ganglion of the trunk.* — This ganglion is connected intimately with the hypo-glossal nerve, and branches pass between it and the ganglion of the sympathetic, and between it and the loop of the first two cervical nerves. The pneumo-gastric and spinal accessory trunks are connected also by a fasciculus above the ganglion. with ninth, sympathetic, spinal nerves, and spinal accessory.

BRANCHES OF DISTRIBUTION. — These branches arise from the inner side of the nerve, and are directed to the middle line, to supply the pharynx, the larynx, and the heart. Branches to supply

1. The *pharyngeal branch* is an offset from the upper part of the ganglion of the trunk of the pneumo-gastric, which terminates, as the name expresses, in the pharynx. The nerve is directed inwards over the internal carotid artery, and joins the branches of the glosso-pharyngeal nerve on that vessel. Finally it courses to the side of the middle constrictor muscle, and communicates with branches of the glosso-pharyngeal, superior laryngeal, and sympathetic nerves, to form the pharyngeal plexus of the same side. pharynx, and join glosso-pharyngeal and pharyngeal plexus.

2. The *superior laryngeal nerve* is much larger than the preceding branch, and arises from the middle of the ganglion of the trunk of the vagus. From this spot the nerve inclines obliquely inwards beneath the internal carotid artery, and reaches the larynx opposite the interval between the hyoid bone and the thyroid cartilage. The nerve then perforates the thyro-hyoid membrane, and is distributed to the mucous membrane of the larynx. (See "LARYNX.") In the neck it furnishes the following branch to the external laryngeal muscles and the thyroid body. To enter larynx, and supply it and

a. The *external laryngeal branch* arises in the neck, beneath the inter- a branch

outside larynx — nal carotid artery. Taking a course similar to the superior laryngeal nerve, but below it, this small branch reaches the side of the larynx, to crico-thyroid, and thyroid body. — and gives offsets to the pharyngeal plexus. Finally the nerve is continued beneath the sterno-thyroideus, to supply the crico-thyroid muscle and the thyroid body. Near its origin this branch communicates with the sympathetic nerve (superficial cardiac branch).

Branches to the heart at upper and lower part of neck. — 3. *Cardiac branches.*—Some small cardiac nerves arise from the pneumo-gastric at the upper part of the neck, and join branches (cardiac) of the sympathetic. At the lower part of the neck on each side there is a single cardiac nerve; that of the right side enters the chest, and joins one of the deep nerves of the heart from the sympathetic; and on the left side the corresponding nerve terminates in the superficial cardiac plexus of the thorax.

Another branch to larynx, — 4. The *inferior laryngeal* or recurrent nerve of the right side leaves the pneumo-gastric trunk opposite the subclavian artery, and winding round that vessel takes an upward course in the neck ends in muscles in interior. — to the larynx. To reach its destination, the nerve ascends beneath the common carotid and inferior thyroid arteries, and then between the trachea and the œsophagus. At the larynx it enters beneath the ala of the thyroid cartilage, and it will be afterwards followed It has — into the interior. The following branches arise from it:—

branches to heart, — *a.* Some *cardiac branches* leave the nerve as it turns round the subclavian artery; these enter the thorax, and join the cardiac nerves of the sympathetic.

to trachea, and œsophagus. — *b. Muscular branches* spring from the recurrent nerve whilst it lies between the trachea and the œsophagus, and are distributed to both those tubes. Near the larynx also some filaments are furnished to the inferior constrictor muscle.

Left recurrent nerve. — On the left side of the body the recurrent nerve arises in the thorax, opposite the arch of the aorta, around which it turns. In the neck its position is between the trachea and the œsophagus, as on the right side.

Spinal accessory in foramen — C. The SPINAL ACCESSORY NERVE passes through the foramen lacerum, in close contact with the pneumo-gastric, to which it is united, but it is not marked by any ganglion while in the foramen.

and below it, — After leaving the foramen, the nerve gives an offset to the trunk of the pneumo-gastric, and takes a backward course crosses neck to trapezius. — through the sterno-mastoid muscle, and across the side of the neck to the trapezius muscle. At first the nerve is somewhat concealed by the jugular vein, but it then passes either

over or under that vein to take the course above indicated. The connections and distribution of the nerve beyond the sterno-mastoideus have been already examined.

This nerve furnishes chiefly muscular offsets, its branches of union with other nerves being but few. Branches join it

Connecting branches.—In the jugular foramen the nerve is united by two filaments with the ganglion of the root of the vagus. to vagus in foramen,

Below the foramen a fasciculus passes from this nerve to the pneumogastric; it is continued over the ganglion of the trunk of the vagus, and then becomes blended with that nerve, furnishing offsets to each muscular branch of the vagus, according to Bendz. and to vagus below foramen.

The *branches of distribution* are supplied to the sterno-mastoid muscle and the trapezius. Supplies muscles.

The HYPO-GLOSSAL OR NINTH NERVE, after passing from the cranium by the anterior condyloid foramen, lies deeply beneath the internal carotid artery and the jugular vein. It then comes forwards between the vein and the artery, turning round the outer side of the vagus, to which it is closely united. The nerve next descends in the neck, and becomes superficial below the digastric muscle, in the anterior triangular space. From this spot the nerve is directed inwards to the tongue and its muscles. Ninth nerve crosses inwards to tongue.

The *branches* of this nerve are furnished to the muscles on the fore part of the neck, and to the muscular substance of the tongue; but there are also some branches connecting it with other nerves near the skull. Branches join it with

Connecting branches.—Near the skull the hypo-glossal is connected by branches with the vagus nerve, and the two are sometimes almost inseparably united. the vagus,

Rather lower down the nerve has connecting branches with the sympathetic, and the loop of the first two spinal nerves. sympathetic, and spinal,

The *branches of distribution* are included in the description of the dissection of the neck, the submaxillary region, and the tongue. and supplies muscles.

Dissection.—Remove the cellular membrane from the small rectus capitis lateralis muscle, between the transverse process of the atlas and the base of the skull. At its inner border seek the anterior branch of the first cervical nerve, which joins in the loop of the atlas. Dissection.

Rectus lateralis is between skull and transverse process of first vertebra.

The RECTUS CAPITIS LATERALIS is a small thin muscle, which is analogous to an inter-transverse muscle. It *arises* from the upper part of the transverse process of the atlas, and is inserted into the jugular eminence of the occipital bone, close behind the foramen lacerum. On the anterior surface rests the jugular vein; and the posterior is in contact with the vertebral artery. To the inner side is the anterior branch of the first cervical nerve.

Dissection.

Dissection. — Trace backwards now the anterior branch of the first cervical nerve to its ganglion. For this purpose divide the rectus lateralis muscle, observing the branch of nerve to it; then cut off the end of the transverse process of the atlas, and remove the vertebral artery, so as to bring into view the anterior part of the suboccipital nerve.

Sub-occipital nerve

The *anterior division* of the *first*, or sub-occipital *nerve*, is a slender nerve that arises in the common trunk on the arch of the atlas. From that origin it is directed forwards on the atlas, beneath the vertebral artery, to the inner side of the rectus lateralis. Here the nerve bends down in front of the transverse process, and forms a loop by uniting with the second cervical nerve. Branches pass between this loop and the vagus, ninth, and sympathetic nerves. As the nerve passes forwards, it supplies the rectus lateralis muscle, and sends a filament along the side of the vertebral artery.

lies on atlas, forms a loop with second. Branches.

Sympathetic nerve in neck has three ganglia,

SYMPATHETIC NERVE. — In the neck, the sympathetic nerve consists of a gangliated cord, on each side, which lies close to the vertebral column, and is continuous with the similar cord in the thorax. On this part of the nerve are three ganglia; one near the skull, another on the neck of the first rib, and a third midway between the two; these are named respectively superior, middle, and inferior ganglion. From the ganglia proceed some branches that are connected with the spinal and most of the cranial nerves, and other branches that are distributed to viscera.

and joins ganglia on fifth nerve.

Besides the ganglia before mentioned, there are other ganglionic masses in connection with the three trunks of the fifth nerve, that communicate with the sympathetic nerve.

Dissection of

Dissection. — To dissect the branches of the sympathetic nerve requires greater care than is necessary in following the white-fibred

nerves, for they are softer, more easily torn, and generally of smaller size. In the neck the ganglia and their branches are already partly exposed, and will therefore require only the following dissection to bring them into view: — the carotid artery and jugular vein being already cut through, the upper ganglion will be seen by raising the trunks of the eighth and ninth nerves, and cutting through the branches that unite these to the loop of the atlas. If it is thought necessary, the two cranial nerves may be cut through close to the skull. The several branches of the ganglion should be traced upwards, inwards, and outwards. Upper ganglion.

The dissector has exposed the middle ganglion on or near the inferior thyroid artery, and he now has to trace out its branches. Middle

To obtain a view of the inferior ganglion, the greater part of the first rib is to be taken away, and a part of the subclavian artery is to be removed, without, however, destroying the fine nerves that pass over it. Of course the clavicle is supposed not to be in position. The ganglion is found on the neck of the first rib; its branches are large, and easily followed to the vertebral artery, the spinal nerves, and the thorax. and inferior ganglion.

A. The SUPERIOR CERVICAL GANGLION is the largest of the cervical ganglia, and is of a reddish grey colour. Of a fusiform shape, it is of the length of two cervical vertebræ (second and third), and is placed on the rectus capitis anticus major muscle, beneath the carotid artery and the cranial nerves in connection with it. Branches either connect the ganglion with other nerves, or are distributed to the blood-vessels, the pharynx, and the heart. Superior ganglion is near skull, beneath carotid.

CONNECTING BRANCHES unite the sympathetic both with the spinal and the cranial nerves. Branches join it

a. With the spinal nerves. — The four highest spinal nerves have branches of communication with the upper ganglion of the sympathetic. But the branch of the fourth spinal nerve may come from the cord connecting the upper ganglion to the next. with spinal nerves.

b. With the cranial nerves.—Near the skull the trunks of the eighth (its lower ganglion) and ninth nerves are joined by branches of the sympathetic. In the foramen lacerum both the petrosal ganglion of the glosso-pharyngeal and the ganglion of the root of the vagus receive small filaments, one to each, from an ascending branch of the ganglion. with cranial and sympathetic outside skull.

Other communications are formed with cranial nerves by means of the offset continued upwards from the ganglion into the carotid canal. and with some in the skull.

BRANCHES OF DISTRIBUTION. — This set of branches is Branch-

es are sent more numerous than the preceding, and the nerves are of larger size.

to external carotid, 1. *Branches of bloodvessels* (nervi molles). These nerves pass to the external carotid artery, and ramify on its branches, forming plexuses on the vessels, which have the same name as the arteries they surround. Some small ganglia are occasionally found on forming plexuses and ganglia; these ramifying branches. By means of the plexus on the facial artery the submaxillary ganglion receives its branch of the sympathetic; and through the plexus on the internal maxillary artery the otic ganglion is supplied with a similar branch.

to internal carotid, With these nerves may be described another offset of the ganglion to the internal carotid artery and its branches. This offset ascends from the upper part of the ganglion, of which it appears to be a continuation. Near the skull it divides into two parts that enter the carotid canal with the artery, one on each side of it, and which join cranial nerves; end in secondary plexuses on the ophthalmic and cerebral branches. The communications and plexuses that these nerves form in their course to the base of the brain are described at p. 19.

to pharyngeal plexus; 2. The *pharyngeal nerves* pass inwards to the side of the pharynx, where they join the other pharyngeal branches of the eighth cranial nerve in the pharyngeal plexus.

to cardiac plexuses. 3. *Cardiac nerves.*—The cardiac nerves enter the thorax to join in the cardiac plexuses of the heart. There are three cardiac nerves on each side, viz. superior, middle, and inferior, each taking its name from the ganglion of which it is an offset.

One nerve to deep plexus The *superior* or superficial *cardiac nerve* of the right side continues through the neck, behind the sheath of the carotid vessels, and enters the thorax beneath, or in front of the subclavian artery. In some bodies this nerve ends in the neck by joining one joins others in neck. of the other cardiac nerves. In the neck the nerve is connected with the cardiac branch of the vagus, the external laryngeal nerve, and the recurrent nerve.

Middle ganglion. B. The MIDDLE CERVICAL GANGLION (gang. thyroideum) is of small size, and is situate opposite the fifth cervical vertebra, usually on or near the inferior thyroid artery. It is Situation. of a roundish shape, and lies beneath the great cervical vessels. Its branches are the following:—

Is joined *Connecting branches* with the spinal nerves pass outwards and sink

between the borders of the longus colli and anterior scalenus to join the fifth and sixth cervical nerves. to spinal nerves,

Branches of distribution.— These consist of nerves to the thyroid body, together with the middle cardiac nerve. and gives offsets, viz.

1. The *thyroid branches* ramify around the inferior thyroid artery, and end in the thyroid body; they join the external laryngeal and recurrent laryngeal nerves. thyroid branches

2. The *middle* or great *cardiac nerve* descends to the thorax across the subclavian artery; its termination in the cardiac plexus will be seen in the chest. In the neck it communicates with the upper cardiac and recurrent laryngeal nerves. and a cardiac nerve.

C. The INFERIOR CERVICAL GANGLION is irregular in shape, and occupies the interval between the first rib and the transverse process of the last cervical vertebra, its position being internal to the superior intercostal artery. Oftentimes it extends in front of the neck of the rib, to join the first swelling of the knotted cord in the thorax. One or two filaments likewise connect these ganglia around the trunk of the subclavian artery, and supply filaments to that bloodvessel. The branches of this ganglion are very similar to those of the other ganglia. Inferior ganglion is on neck of first rib. Branches to blood-vessels,

a. Connecting branches join the last two cervical nerves. Other nerves accompany the vertebral artery in its canal, forming a plexus (*vertebral*) around it, and communicate with the spinal nerves as high as the fourth. and spinal nerves,

b. Only one branch of distribution, the *inferior cardiac nerve*, issues from the lower ganglion. It lies beneath the subclavian artery, where it joins the recurrent laryngeal nerve, and then enters the thorax to terminate in the deep cardiac plexus behind the arch of the aorta. and one nerve to cardiac plexus.

SECTION X.

LEFT SIDE OF THE NECK.

IN the dissection of the left half of the neck, the differences observable between it and the right side are specially to be studied. When the description of the right side will suffice, reference will be made to it. Left side differs from right.

Dissection of anterior triangle

Dissection.—Make tense the neck over a narrow block, as on the opposite side, and dissect out the anterior triangle and the anterior part of the neck. Use the description of the right side for both those regions, and for the examination of the sterno-mastoid and the small lower hyoid muscles.

of scaleni and subclavian artery.

Next take the scaleni muscles, and the subclavian vessels. The dissection of the vessels on the right side will serve for those on the left, except that the student will meet on the left side with the thoracic duct. This little tube will be seen in connection with the part of the artery internal to the scalenus muscle, and afterwards to cross in front of the scalenus to join the subclavian vein. On this side, too, the clavicle may remain articulated.

Subclavian artery differs much from right subclavian

The LEFT SUBCLAVIAN ARTERY arises from the arch of the aorta, in place of the innominal artery, and ascends thence, over the first rib, in its course to the upper limb. With this difference on the two sides in the origin of the subclavian, the one vessel beginning opposite the sterno-clavicular articulation, the other in the thorax, it is obvious that the length and connections of the part of the artery on the inner side of the scalenus must vary much on opposite sides.

in the first part of its extent.

First part.—The part of the artery internal to the anterior scalenus is much longer on the left than the right side, and is almost vertical in direction, instead of being horizontal, like its fellow vessel. Moreover it is deeply placed in the neck, near the spine and the œsophagus, and does not rise so high above the first rib as the right subclavian.

Connections with surrounding parts.

Between the artery and the surface are the same parts as cover the right vessel, viz. the common teguments and deep fascia, with the sterno-mastoid, hyoid, and thyroid muscles. Behind the vessel is the longus colli muscle, with the inferior ganglion of the sympathetic. To the inner side are the œsophagus and thoracic duct; and the pleura is in contact with the anterior and outer parts.

Position of vagus and internal jugular vein to it.

The pneumo-gastric nerve is in connection with this part of the artery, but its position is parallel to the vessel instead of across it, as on the right side. The internal jugular vein, in like manner, is parallel to the artery for a short distance, and superficial to it. Accompanying also the subclavian artery are the cardiac branches of the sympathetic, which course along the side of the vessel to the chest.

The *second* and *third* parts of the artery, viz. beneath and beyond the scalenus, are the same as on the right side. Rest of the artery.

The *branches* of the artery resemble so closely those of the right side, that one description will serve for both. It may be remarked that the superior intercostal of the left side is usually internal to the scalenus, instead of beneath it; in other words, this branch arises sooner (see p. 63.). Branches resemble those of right vessel.

The *thoracic duct* conveys the chyle and lymph of the greater part of the body into the venous circulation. Escaping from the thorax, between the subclavian artery and the œsophagus, the duct ascends in the neck as high as the seventh or sixth cervical vertebra. At the spot mentioned as its highest extent, the duct arches outwards above the subclavian artery, but in front of the scalenus muscle and phrenic nerve, to open into the subclavian vein, rather external to the union of this with the jugular vein. Two valves guard the opening of the duct into the posterior part of the vein, and most commonly the upper part of the duct is divided. Thoracic duct comes from thorax and joins subclavian vein.

Examine next the brachial and cervical plexuses, using the description of the right side, p. 68. Spinal nerves.

Between the *common carotids* of opposite sides there is also a difference, like that between the right and left subclavian arteries; for on the left side the vessel arises separately from the arch of the aorta, and is, therefore deep in the chest and longer than the right. The part of the artery between its origin and the upper piece of the sternum will be seen in the dissection of the thorax. Difference in origin of right and left carotids.

Beyond the sterno-clavicular articulation the vessels on both sides so nearly resemble one another that the same description will serve for the two (p. 71.). It must be remembered, however, that on the left side the jugular vein and the pneumo-gastric nerve are much nearer to the accompanying artery than on the right side; indeed, the left vein commonly overlays the artery at the lower part of the neck. In the neck nearly the same anatomy.

The THYROID BODY is a soft reddish mass, situate on the sides of the upper part of the trachea. It consists of two lobes, one on each side, which are united across the front of the windpipe, opposite the second and third rings, by a Thyroid body consists of two lobes united by

a cross piece. narrow piece, half an inch in depth (isthmus). Each lobe is somewhat conical in shape, with the smaller end upwards, and *Connections and* is about two inches in length. It is interposed between the sheath of the common carotid artery and the windpipe, where it is covered by the sterno-thyroid, sterno-hyoid, and omo-*extent of lobes.* hyoid muscles. The extent of the lobe depends upon the variations in its size, but commonly the lateral piece reaches as high as the ala of the thyroid cartilage, and as low as the sixth ring of the trachea.

Accessory piece or pyramid. From the upper part of the thyroid body, but most commonly from the left lobe, there is occasionally found a conical piece (pyramid) ascending towards the hyoid bone, to which it is connected by a fibrous band. Sometimes this part is attached to the hyoid bone by a slip of muscle (levator glandulæ thyreoideæ of Sœmmerring).

Weight and size. This body is of a brownish red or purple hue, and weighs from one to two ounces. Its size is larger in the woman than in the man. No excretory tube has been found attached to it.

No distinct capsule. *Structure.* — The thyroid body is not provided with a distinct capsule, but is surrounded by cellular tissue, that projects into its substance and divides it into masses.

Consists of vesicles The substance of the gland consists of spherical or elongated vesicles, which vary in size, some being as large as the head of a small pin, and others only $\frac{1}{850}$ of an inch. These vesicles are simple sacs, containing a yellow fluid with nuclear bodies. Capillary vessels and areolar tissue connect the vesicles together into small masses or lobules, the size of the little finger nail. On cutting into *and yellow fluid.* the gland a viscid yellowish fluid escapes.

Bloodvessels. *Bloodvessels.* — The *arteries* to the thyroid body are two on each side (superior and inferior thyroid), and occasionally there is an additional branch (lowest thyroid), of the innominal artery. The *Superior, inferior, and lowest thyroid arteries.* branches of the external carotid (superior thyroid) ramify chiefly on the anterior aspect; while those from the subclavian (inferior thyroid) pierce the under surface of the thyroid body. A very free communication is established between all the arteries. The *Veins.* *veins* are also large and numerous; they are superior, middle, and inferior thyroid on each side. The first two have been traced to *Inferior form a plexus on the trachea.* the internal jugular vein. The *inferior thyroid vein* issues from the lower part of the thyroid body, and descends on the trachea, the two forming a plexus on that tube beneath the sterno-thyroid

muscle; the right vein joins the superior cava, and the left enters the innominal vein.

The TRACHEA, or air tube, is continued from the larynx to the thorax, and ends by dividing into two tubes (bronchi), one for each lung. It occupies the middle line of the body, and extends from the fifth cervical to the third dorsal vertebra, measuring about four inches and a half in length, and nearly one in breadth. The front of the trachea is rounded, and its cavity is always pervious, in consequence of the existence of firm cartilaginous bands in the anterior wall, but at the posterior aspect the cartilages are absent, and the tube is flat and muscular.

Trachea lies in neck and thorax.

Form.

The cervical part of the trachea is very moveable, and has the following relative position to the surrounding parts. Covering it in front are the small muscles from the sternum to the hyoid bone, with the deep cervical fascia: beneath the muscles is the plexus of veins (inferior thyroid), and near the larynx is the isthmus of the thyroid body. Behind the tube is the œsophagus, with the recurrent nerves. On each side are the common carotid artery and the thyroid body.

Cervical part is amongst muscles and vessels.

The ŒSOPHAGUS, or gullet, reaches from the pharynx to the stomach. It commences, like the trachea, opposite the fifth cervical vertebra, and ends opposite the tenth dorsal vertebra. In length it measures about nine inches. This tube reaches through part of the neck, and through the whole of the thorax, and occupies, for the most part, the middle line of the body.

Œsophagus occupies neck and thorax.

In the neck its position is behind the trachea, but near the thorax it projects to the left side, beyond the air tube, and comes into connection with the thyroid body and the thoracic duct. Behind the œsophagus is the longus colli muscle; and on each side is the common carotid artery, the proximity of the left being greatest, because of the projection of the œsophagus towards the same side.

Position in neck and connections.

Let the dissector examine next the digastric and stylo-hyoid muscles with the hypo-glossal nerve; also the trunk of the external carotid, and its following branches, viz. superior thyroid, facial, occipital, posterior auricular, and superficial temporal. The description of the right side may be used for these parts, p. 72.

Muscles and nerves in anterior triangle.

Pterygo- and sub-maxillary regions to be omitted.

The dissector is not to examine the pterygo-maxillary or sub-maxillary regions on this (the left) side of the neck, because the proceeding would interfere with subsequent dissections. Before learning the pharynx he will expose on this side only the middle and inferior ganglia of the sympathetic and their branches.

Dissection of sympathetic, viz. middle and lower ganglia.

Dissection.—To expose the two lower ganglia of the sympathetic and their branches, cut across the common carotid artery at the lower part of the neck, and the external and internal carotid where they are crossed by the digastric muscle. Now remove these vessels with the internal jugular vein, and be careful of the sympathetic beneath them. Cut through the middle of the first rib, and take away the upper end of the sternum with the attached clavicle. Set aside the piece of bone thus obtained for the subsequent examination of the sterno-clavicular articulation. The middle ganglion will be found in the cellular membrane near the inferior thyroid artery; and the inferior one will be seen on the neck of the first rib, after a piece of the subclavian artery has been taken away. The upper cardiac nerve will be found descending beneath the carotid sheath.

Ganglia of sympathetic nerve.

The *middle* and *inferior cervical ganglia* of the sympathetic nerve are so similar to the corresponding ganglia of the right side, that the same description will suffice (page 109.).

Cardiac nerves.

The *cardiac nerves* are three in number on the left, as on the right side, viz. superior, middle, and inferior, but they present some peculiarities.

Upper

a. The *superior cardiac nerve* has on both sides a similar course in the neck; but the left in entering the chest is between the carotid and subclavian arteries, and parallel to them.

Middle.

b. The *middle cardiac nerve* frequently joins the next nerve, and passes beneath the subclavian artery to the deep cardiac plexus.

Lower.

c. The *inferior cardiac nerve* is generally a small branch that enters the thorax conjoined with the preceding, and ends in the cardiac plexus.

SECTION XI.

THE PHARYNX.

To examine the pharynx, it will be necessary to cut through the base of the skull, so as to detach that part from the rest of the body.

Dissection to detach the pharynx. — Remove the block from beneath the neck, and place the head downwards, letting it stand on the cut surface of the skull. Then divide the trachea and œsophagus with the vagus and sympathetic nerves near the first rib (if these are not cut), and separate all from the spine as high as the basilar process of the occipital bone, taking care to leave undisturbed on the left side the vessels and nerves near the skull. Afterwards let the dissector chisel through the basilar process of the occipital bone, between the attachment of the pharynx and the muscles of the spinal column, the cut being directed backwards. To detach pharynx partly divide base of skull externally,

Turning upwards the inner surface of the base of the skull, the dissector will now make the following incisions in the posterior fossa. On the right side cut with a chisel along the line of union of the petrous part of the temporal with the occipital bone as far forwards as the incision across the basilar process. Also, on the left side, cut with the chisel through the occipital bone, internal to the foramen lacerum jugulare and the inferior petrosal sinus: this cut is to begin rather behind the foramen lacerum, and to end opposite the one on the other side. Lastly, saw through the side of the skull close behind the mastoid part of the temporal bone, so as to meet the posterior end of the cut made with the chisel. The base of the skull is now divided into two parts (one having the pharynx attached to it, the other articulating with the spine), which can be readily separated with a scalpel. and cut the remainder from inside. and then cut soft parts.

The spinal column, with the piece of the occipital bone connected with it, should be set aside, and kept for after examination. Preserve piece of spine.

Dissection of the pharynx.—Let the student take the anterior part of the divided skull, fill the pharynx with tow, and fasten it with hooks on a block, so that the œsophagus may be pendent and towards him. Fasten pharynx in position.

On the left side of the pharynx a view may be obtained of the eighth, ninth, and sympathetic nerves near the skull, after the removal of some cellular membrane, and detaching the styloid process with its muscles. Dissect nerves on left side.

and muscles on the opposite. Afterwards, on one side, usually the right, proceed to remove the fascia from the muscular fibres of the constrictors, which radiate from the side to the middle line. The margins of the two lower constrictor muscles (middle and inferior) should be next defined. Beneath the lower one, near the larynx, will be found the recurrent nerve; whilst intervening between the middle and superior is the stylo-pharyngeus muscle, with the glosso-pharyngeal nerve. To see the attachment of the superior constrictor to the lower jaw and the pterygo-maxillary ligament, it will be necessary to cut through the internal pterygoid muscle. Above the upper fibres of this last muscle, and near the base of the skull (petrous part of the temporal bone) will be found two small muscles of the palate; one, tensor palati, lies between the internal pterygoid plate and the pterygoid muscle; and the other, levator palati, is rather farther back, and of larger size.

Pharynx is behind mouth and nose. Extent, form, and length; The PHARYNX is the upper dilated part of the alimentary passage, and is situate behind the mouth, nose, and larynx. Its extent is from the base of the skull to the cricoid cartilage of the larynx, where it ends in the œsophagus. In form it is somewhat conical, with the wide part upwards and the narrower part downwards; and in length it measures about four inches and a half.

is an incomplete bag; is between blood-vessels and in front of spine. The bag of the pharynx is incomplete in front, but is closed behind by three thin muscles, which are so arranged that the lower overlays the middle one, and the middle the upper muscle, like the disposition of scales; and the bag is farther completed by an aponeurotic expansion, which fixes it to the base of the skull. The whole is lined by mucous membrane. On each side of the pharynx are the trunks of the carotid arteries, with the internal jugular vein, and the accompanying eighth, ninth, and sympathetic nerves. Behind it is the spinal column, covered by the deep muscles, viz. longus colli and rectus capitis anticus major.

Aponeurosis of pharynx. The *aponeurosis* of attachment is seen at the upper part of the pharynx, where the muscular fibres are deficient, to connect the muscular bag to the base of the skull, and to complete its posterior boundary. Superiorly, it is fixed to the basilar process of the occipital bone, and to the petrous part of the temporal bone; but inferiorly it becomes thin and cellular, and extends between the muscular and mucous coats.

On this membrane some of the fibres of the constrictor muscles terminate.

The INFERIOR CONSTRICTOR MUSCLE, the most superficial of the muscles of the pharynx, *arises* from the side of the cricoid cartilage, from the oblique line on the ala of the thyroid cartilage, and from the part of the last cartilage behind that line. The origin is small when compared with the insertion, for the fibres are directed backwards, radiating, and are *inserted* along the middle line with the corresponding muscle of the opposite side. The outer surface of the muscle is in contact with the sheath of the carotid artery and the muscles covering the spinal column. The lower border is straight, and marks the line of separation between the pharynx and œsophagus, whilst the upper border overlaps the fibres of the middle constrictor. The recurrent nerve enters beneath the lower border.

Lower constrictor muscle arises from larynx and ends in middle line.

Parts in contact with it.

The MIDDLE CONSTRICTOR MUSCLE is of the same shape as the preceding; that is to say, narrow in front and expanded behind. Its fibres *arise* from the great cornu of the os hyoides, from the small cornu of the same bone, and from the stylo-hyoid ligament. From this origin the fibres radiate, and are blended along the middle line with the other muscles. The surfaces of the muscle have connections similar to those of the preceding constrictor. The upper border is separated from the superior constrictor by the stylo-pharyngeus muscle and the glosso-pharyngeal nerve, and ends on the aponeurosis of the pharynx near the base of the skull. The lower border descends beneath the inferior constrictor, and between the two is the superior laryngeal nerve.

Middle constrictor passes from hyoid bone to middle line behind.

Connections.

The *stylo-pharyngeus muscle* may be again seen with the pharynx. Its description is given at p. 97.

Stylo-pharyngeus.

The SUPERIOR CONSTRICTOR is the least marked of the three muscles, and wants the regular or conical form. Its *origin* is extensive, being connected with the inner surface of the internal pterygoid plate (its lower third), with the pterygo-maxillary ligament, with the posterior part of the mylo-hyoid ridge of the lower jaw, and with the side of the tongue. The fleshy fibres pass backwards and are *inserted* into the aponeurosis of the pharynx as well as into the *raphé*

Upper constrictor.

Origin in front.

Insertion behind as

the others. along the middle line. The parts in contact externally with this muscle are all the deep vessels and nerves of the neck; internally it is lined by the aponeurosis and the mucous membrane. Above the upper border, which consists of the fibres directed backwards from the pterygoid plate, are seen the levator and tensor palati muscles. The lower border has been seen to be overlaid by the middle constrictor muscle. The attachment to the pterygo-maxillary ligament corresponds to the origin of the buccinator muscle.

Contiguous parts.

Dissection. *Dissection.* — Open the pharynx by an incision along its middle, remove from it the tow, and keep it open with hooks. A better view of the cavity will be obtained by partly dividing the occipital attachment on each side.

Interior of pharynx. The *interior of the pharynx* is widest opposite the hyoid bone, and in it the following objects are to be noticed: —

Objects to be noted. Above are the posterior openings of the nares, which are separated by the septum nasi; and below them is the soft palate, partly closing the aperture into the mouth. By the side of the opening from the nose is the trumpet-shaped end of the Eustachian tube, one on each side. Below the soft palate is the opening into the mouth (isthmus faucium); and on each side of this is the tonsil, which is placed in a hollow between one prominence from the soft palate to the side of the tongue, and another from the same part to the back of the pharynx (pillars of the soft palate). Next in order below the mouth is the aperture of the larynx, and close in front of it is the epiglottis, or the valve that closes the opening during deglutition. And lowest of all is the opening from the pharynx into the œsophagus.

Seven apertures, viz. The APERTURES into the pharynx are seven in number, and have the following position and boundaries: —

Nares, The *posterior openings of the nares* are two in number. Each is of an oval form, corresponding to the shape of the osseous parts that bound it in the dried skull, and is lined by mucous membrane. The apertures are separated by the vomer, or the posterior part of the septum nasi.

Eustachian tubes; The *Eustachian tube* is a canal, partly osseous, partly cartilaginous, by which the cavity of the tympanum communi-

cates with the external air. Only the cartilaginous part that is external to the bone can now be seen.

If the mucous membrane is removed from the naris on one side, the cartilaginous part of the tube will appear to be about an inch long. It is narrow superiorly, where it is fixed to the margins of a groove between the sphenoid and the petrous part of the temporal bone; and is directed downwards from that spot to open into the pharynx by a wide aperture on the inner surface of the internal pterygoid plate, rather above the inferior spongy bone of the nose. The opening in the pharynx is oval in form; and the inner side, which is larger than the outer, projects forward, giving rise to the trumpet-shaped mouth. This part of the tube is constructed of a piece of fibro-cartilage, which is bent downwards, and encloses an angular space; but inferiorly the cartilage is deficient, and the space is limited by fibrous membrane. Closely united to the pterygoid plate, the tube is covered by the mucous membrane; and through it the cavity of the tympanum receives its mucous lining from the pharynx.

Cartilaginous part is an inch long, has a wide opening; is a bent piece of cartilage. Mucous membrane covers and lines it.

The *isthmus faucium* is a somewhat narrowed passage between the mouth and the fauces, whose size is altered by the elevated or pendent position of the soft palate. The space is bounded below by the root of the tongue; above, by the soft palate; and on each side by the prominence of the anterior pillar of the soft palate.

Opening of fauces.

The *aperture of the larynx* is wide in front, where it is bounded by the epiglottis, and pointed behind, between the arytænoid cartilages. The sides are sloped from before back, and are formed by folds of the mucous membrane extended between the arytænoid cartilages and the epiglottis. During respiration, this aperture is unobstructed, but during the act of deglutition it is closed by the epiglottis.

Upper opening of larynx.

The *opening into the œsophagus* is the narrowest part of the pharynx, and is opposite the cricoid cartilage or the fifth cervical vertebra. Internally, the mucous membrane of the œsophagus is paler than in the pharynx; and externally the point at which the pharynx ends is marked by a slight contraction, and by a change in the direction of the muscular fibres.

Beginning of œsophagus.

Soft palate is at back of mouth; The SOFT PALATE (velum pendulum palati) is a moveable structure between the mouth and the pharynx, which can either close the isthmus of the fauces, or cut off the passage to the nose, according as it is depressed or elevated. In the usual position of the soft palate (the state of relaxation) the anterior surface looks forwards, and is continuous with the roof of the mouth, whilst the opposite surface is turned to the pharynx. The upper border is fixed to the posterior margin of the hard palate, and joins the pharynx on the side. The lower border is free, and presents in the centre an elongated pendulous part (the uvula), whilst on each side it is somewhat arched, forming the half arch of the palate. Along the middle line is a slight prominence, indicative of the original separation into two halves.

surfaces, borders; from it hangs uvula.

Elements of velum. The velum consists of an aponeurosis, together with muscles, vessels, nerves, and mucous glands, and the whole is enveloped by the mucous membrane.

Dissection of the muscles. *Dissection.*—To expose the thin pale fibres of the azygos uvulæ muscle, raise with care the mucous membrane along the middle line of the soft palate, at the posterior aspect. On each side are the two chief muscles of the soft palate—the elevator and tensor: these have been partly exposed on the outside of the pharynx; but to follow them to their destination, take away the upper attachment of the pharynx on the right side, and the part of the superior constrictor which arises from the internal pterygoid plate. Now the levator will be fully exposed by the removal of the mucous membrane covering its lower part, and the tendon of the tensor palati can be followed round the hamular process of the pterygoid plate. The position of the Eustachian tube with respect to the muscles should be defined.

Aponeurosis of palate. *Aponeurosis of the soft palate.*—Giving strength to the velum is an aponeurosis, which is attached to the hard palate. This structure becomes thinner as it descends in the velum, and it is joined by the tendon of the tensor palati muscle.

Nine muscles: The MUSCLES of the soft palate are four on each side,—an elevator and tensor, together with the palato-glossus and palato-pharyngeus, which act as depressors. In addition, there is a small central azygos muscle.

The AZYGOS UVULÆ is the most superficial muscle on the posterior aspect of the soft palate. Occupying the middle line of the velum, the muscle consists of two narrow slips of pale fibres, which *arise* from the spine at the posterior border of the hard palate, and end inferiorly in the tip of the uvula. Azygos muscle is single along middle.

The LEVATOR PALATI is a thick, roundish muscle, which is partly situate outside the pharynx. It *arises* from the under surface of the apex of the petrous part of the temporal bone, and slightly from the cartilage of the Eustachian tube. The fibres descend, enter the pharynx above the superior constrictor, and then spread out in the soft palate, some joining along the middle line with those of the muscle of the opposite side. This muscle rests on the Eustachian tube, and is concealed in the velum by the azygos uvulæ. Elevator muscle arises outside pharynx, and is lost in velum;

The TENSOR vel CIRCUMFLEXUS PALATI is a thin, riband-like band, which is tendinous at its deep border, and is situate between the internal pterygoid plate and the pterygoid muscle. The muscle *arises* from the slight depression (scaphoid fossa) at the root of the internal pterygoid plate, from the adjoining surface of the sphenoid bone, and from the outer part of the Eustachian tube. Inferiorly, the fleshy fibres end in a tendon, which is reflected round the hamular process, and widening in the soft palate, is *inserted* partly into a ridge on the under surface of the palate bone, and partly into the aponeurosis of the velum. As the tendon winds round the bone, it is thrown into folds, and in the soft palate it has a deeper position than any of the other muscles. The Eustachian tube is directed inwards, between this muscle and the preceding one. Tensor muscle arises outside pharynx, turns around hamular process, and ends in aponeurosis; is deeper than others.

Dissection.—The two remaining muscles will be exposed by taking away the mucous membrane from the prominence before and behind the tonsil: the palato-glossus forms the projection in front of, and the palato-pharyngeus behind the tonsil. Dissection of

The PALATO-GLOSSUS MUSCLE (constrictor isthmi faucium) is a small, fleshy band of fibres, which is extended from the soft palate to the side of the tongue. The muscles of opposite sides narrow the opening between the mouth and fauces; hence the name that has been applied to them. At the in- palato-glossus and

sertion into the tongue the fibres blend with the stylo-glossus.

palato-pharyngeus, The PALATO-PHARYNGEUS is much larger in size than the preceding muscle. Expanding in the soft palate, so as to form a layer beneath the levator palati, the fibres are arched downwards, and are mingled with the muscular fibres of the posterior part of the pharynx. This muscle bounds the tonsil posteriorly, and gives rise to the eminence of the posterior pillar of the soft palate.

or pillars of soft palate.

Tonsil is between pillars of palate. The *tonsil* is a collection of mucous follicles close above the side of the tongue, and between the pillars of the soft palate. It is oval in shape, but variable in size, and the apertures of the follicles are generally apparent on its surface. Externally, the tonsil is opposite the superior constrictor muscle, and posterior to it is the internal carotid artery; but when the tonsil is enlarged it may touch that artery.

Mucous membrane of pharynx continues into the apertures. The *mucous membrane of the pharynx* is continuous anteriorly with the mucous lining of the mouth and nose. Covering the soft palate and its numerous small glands (palatine), the membrane is continued to the tonsils on each side, and is prolonged by the Eustachian tubes to the tympanum. From the dorsum of the tongue it is continued over the epiglottis, forming its three small anterior folds, and then lines the pharynx. In front of each arytænoid cartilage it encloses a mass of muciparous glands (arytænoid), and then sends a prolongation into the larynx. Inferiorly, it is continued by the œsophagus to the stomach.

Superiorly has columnar, inferiorly scaly epithelium. The mucous membrane is thickest in the upper part of the pharynx, and its character near the different apertures resembles the membranes lining the cavities that open into the pharynx. Its epithelium is scaly below the nose, but columnar and ciliated above that spot.—(Henlé.)

Size. *Structure of the œsophagus.*—It may be remarked, in addition to what has been said of the commencement of the œsophagus and its connections in the neck, that the size of this tube is less than that of the pharynx, and that the walls are flaccid.

On dissection, the tube will be found to consist of two layers of muscular fibres, with a lining of mucous membrane. Formed of two layers of fibres;

The *external layer* is formed of longitudinal fibres, which commence opposite the cricoid cartilage by three bundles, anterior and two lateral; the former is attached to the ridge at the back of the cartilage, and the others join the inferior constrictor. The *internal layer*, on the other hand, is formed by circular fibres, which are continuous with those of the constrictor. The structure of the œsophagus is described more fully in the dissection of the thorax. outer or longitudinal, and inner or circular.

Section XII.

THE MOUTH.

With the mouth may be examined the cheeks, the lips, and the teeth, all which may be considered accessory parts.

The Mouth.—The cavity of the mouth is situate below the nose, and extends from the lips in front to the isthmus of the fauces behind. Its boundaries are partly osseous and partly muscular, and its size depends upon the position of the lower jaw. When the lower jaw is moderately removed from the upper one, the mouth is an oval cavity with the following boundaries. The *roof* is generally concave, and is formed by the hard and soft palate, and is limited anteriorly by the arch of the teeth. In the *floor* is the tongue, bounded by the arch of the lower teeth, and beneath the tip of that body is the frænum linguæ, with the sublingual gland on each side. Each *lateral boundary* consists of the cheek and the ramus of the lower jaw; and in it, near the second molar tooth in the upper jaw, is the opening of the parotid duct. The anterior opening of the mouth is bounded by the lips, and the posterior corresponds to the pillars of the soft palate. Mouth. Situation, form, and boundaries.

The *mucous membrane* of the mouth is much thicker on the hard than the soft parts of the cavity, and after lining the interior and covering the tongue, it is continuous anteriorly with the tegument, and posteriorly with the lining of the pharynx. Lining of mouth;

On tracing its disposition, the membrane is seen to form a small fold (frænulum) between the lip and the gum of the corresponding differs in parts,

on roof, jaw. On the bony part of the roof it is thick and thrown into folds, and covers vessels, nerves, cellular tissue, and glands; but on the soft palate it is smooth and thinner. Along the middle of floor, the palate is a ridge, which ends in front in a small papilla. In the floor of the mouth the membrane forms the frænum linguæ beneath the tip of the tongue, and sends tubes into the openings of the Whartonian and sublingual ducts; whilst on each side of the frænum it is raised into a crest by the subjacent sublingual gland. cheek, and lips. On the interior of the cheek and lips the mucous lining is smooth, and is separated from the muscles by small buccal and labial glands. The epithelium covering the membrane is of the scaly variety.

Cheek; extent and structure. The CHEEK extends from the commissure of the lips to the ramus of the lower jaw, and is attached above and below to the alveolar process of the jaw on the outer aspect. The chief constituent of the cheek is the fleshy part of the buccinator muscle: on the inner surface of this is the mucous membrane; and on the outer, the integuments, together with vessels and nerves. The parotid duct perforates the cheek opposite the second molar tooth of the upper jaw, and receives a lining of the mucous membrane.

Lips, formed by orbicularis; The LIPS surround the opening of the mouth, in the same way as the eyelids limit their intervening aperture. They consist of the fleshy part of the orbicularis oris muscle, covered externally by integument, and internally by mucous membrane. The lower lip is the larger and more moveable of the two. Between the muscular structure and mucous covering are the labial glands; and in the substance of the contain coronary artery. lip, nearer the inner than the outer aspect, is the arch of the coronary artery.

Teeth, number and arrangement in jaw; TEETH.—In the adult there are sixteen teeth in each jaw, which are set in the alveolar border of the maxilla, in the form of an arch, and are surrounded by the gums. Each dental arch has its convexity turned forwards, and, commonly, the arch in the upper maxilla overhangs that in the lower maxilla when the jaws are in contact. The teeth are similar in the half of each jaw, and have received the following different kinds. names:—the most anterior two are incisors, and the one next behind is the canine tooth; two, still farther back, are the bicuspid teeth, and the last three are molar teeth. Moreover, the last molar tooth has been also called "dens sapi-

entiæ," from the late period of its appearance. The names applied to the teeth indicate very nearly the part they perform in mastication; thus the incisor and canine teeth act as cutters of the food, those of the different jaws passing each other like the blades of a scissors, whilst the bicuspid and molar teeth serve to grind the aliment.

Use in mastication.

The several parts of the teeth, viz. the crown, fang, and neck; the general and special characters of these parts, and of the different groups of the teeth; and the structure of the different components of a tooth, must be referred to elsewhere. — (Quain's *Anatomy*.)

Fuller notice elsewhere.

Section XIII.

CAVITY OF THE NOSE.

To obtain a view of the interior of the nose, it will be necessary to make a longitudinal section through the base of the skull.

Dissection. — Before making the necessary sawing of the bone, the loose part of the lower jaw on the right side should be taken away; also the tongue, hyoid bone, and larynx, all united, may be detached from the opposite half of the lower jaw, and set aside till the dissector is ready to begin them.

Dissection before sawing bone.

Place the saw on the right side of the crista galli of the ethmoid bone, and carry it vertically through the frontal and nasal bones, the cribriform plate of the ethmoid, and part of the body of the sphenoid bone. Now turn upwards the roof of the mouth, and after dividing the soft parts, saw through the hard palate on the right side of the septum nasi; also through the body of the sphenoid bone in such a direction as to make the cut join the incision from above. The piece of the skull is easily separated into two parts, right and left; and by proceeding as above directed, the delicate bones of the nose are less injured than they would be by sawing uninterruptedly in one direction. The right half will serve for the examination of the meatuses, and the left shows the septum nasi.

Cut through the bone with saw.

In examining the boundaries of the nose, the student should use a section of a skull.

The CAVITY OF THE NOSE occupies the centre of the bones of the face, and is situate above the mouth, and between the

Situation of nose.

orbits and the sinuses of the superior maxillary bones. This space is divided into two parts (nasal fossæ) by a vertical partition, and each fossa has an opening both in the face and the pharynx, as well as apertures of communication with the sinuses in the surrounding bones, viz. frontal, ethmoid, sphenoid, and superior maxillary.

Division into two. Openings.

Each nasal fossa presents for examination a roof, a floor, an inner and an outer wall.

Roof. The *roof* is somewhat arched, and is formed by the cribriform plate of the ethmoid bone in the centre, by the nasal bone and cartilages in front, and by the body of the sphenoid, and part of the palate bone at the posterior part.

Floor. The *floor* is slightly hollowed from side to side, and in it are found the palate and superior maxillary bones—their palate processes. Near the front is the aperture of the anterior palatine canal.

Inner boundary partly osseous, partly cartilaginous. The *inner boundary* (septum narium) is partly osseous and partly cartilaginous, and will be seen when the lining membrane is removed. The osseous part consists of the perpendicular plate of the ethmoid bone and the vomer. The irregular space in front is filled by the *triangular cartilage of the septum*, which forms part of the partition between the nostrils, and supports the cartilages of the anterior aperture. Fixed between the vomer, the ethmoid plate, and the nasal bones, the cartilage rests anteriorly on the median ridge between the superior maxillary bones, and projects even beyond, between the cartilages of each nostril. The septum narium is commonly bent to one side.

Outer boundary. The *outer boundary* has the greatest extent and the most irregular surface. The bones entering into this wall are, the superior maxillary, the lateral mass of the ethmoid bone, with the small os unguis, and posteriorly the ascending part of the palate bone, with the internal pterygoid plate of the sphenoid bone.

is irregular on surface; On this wall are three convoluted osseous pieces, named *spongy* or *turbinate bones*, which project into the cavity; the two upper are but processes of the ethmoid bone, but the lower is a separate bone (inferior spongy).

presents fissures. Between each turbinate bone and the wall of the nose is a longitudinal canal or meatus.

Of the three meatuses, the *upper* one is the smallest, and occupies about the posterior half of the outer boundary; into it the posterior ethmoidal and the sphenoidal sinuses open—the first at the front, the other at the back; and posteriorly is the spheno-palatine foramen, by which the nerves and vessels enter the nose. The *middle meatus* is longer than the preceding, and communicates anteriorly by a funnel-shaped passage (infundibulum) with the frontal sinus and the anterior ethmoidal cells; and about the middle of this meatus is a small aperture into the cavity of the upper jaw. The *inferior meatus* reaches across nearly the whole outer wall of the nasal fossa, and in its front is the opening of the ductus ad nasum.

Upper fissure, or meatus, middle. lower.

The *mucous membrane* that lines the nasal fossæ is called the pituitary or Schneiderian membrane. It is continuous with the integument at the nostrils, and with the membrane lining the pharynx through the posterior opening of the nares; moreover it is also continuous, by means of the openings into the meatuses, with the conjunctiva, and the lining membrane of the different sinuses, viz. frontal, ethmoidal, sphenoidal, and maxillary.

Mucous lining of the nose.

The membrane is, generally speaking, thick, and closely united to the periosteum and perichondrium beneath; but in the canals and sinuses it is very thin, and on the margins of the spongy bones it is projected somewhat by the large submucous vessels, so as to increase the extent of surface. Near the nostril it is furnished with small hairs (vibrissæ). The surface is covered by the apertures of muciparous glands, which are in greatest abundance and of largest size about the middle and posterior parts of the nasal fossæ; and lining the mucous membrane is an epithelium of the columnar ciliated kind, which becomes laminated or scaly near the nostrils. The foramina in the dry bones, that transmit nerves or vessels, are entirely closed by the membrane, viz. naso-palatine, spheno-palatine, and the holes in the cribriform plate; and the apertures that lead to the sinuses and the orbit are much diminished by the lining they receive. At the opening of the ductus ad nasum the lining membrane forms two small folds. From the close connection of the mucous membrane with the periosteum the lining membrane of the nose is sometimes called a fibro-mucous membrane.

Differs on spongy bones and in sinuses.

Covered with apertures of glands and epithelium.

Some foramina closed, others diminished by it.

Dissection of nerves and vessels.

Dissection. — By the time the nose is dissected, little is seen of the distribution of the olfactory nerve. If the septum nasi is removed, so as to leave entire the membrane covering it on the opposite side (the left), the filaments of the nerve will appear on the surface, near the cribriform plate. On the membrane, too, near the front of the septum, is a branch of the nasal nerve. At the same time, the naso-palatine nerve and artery will be seen lower down, being directed from behind forwards, towards the anterior palatine canal. By cutting through the anterior part of the membrane covering the septum, other branches of the olfactory nerve may be traced along the outer wall of the nasal fossa.

Olfactory nerve is distributed to half septum, the roof, and two spongy bones.

The OLFACTORY NERVE forms a bulb on the cribriform plate of the ethmoid bone, from which branches descend to the nose through the apertures in that bone. These branches are divisible into three sets. An inner set descend in the grooves on the septum narium, and branching extend to about the centre. A middle set is confined to the roof of the nose. And an external set is distributed on the two upper spongy bones, and the flat surface of the ethmoid bone in front of them. As the branches of the olfactory nerve leave the skull they receive tubes from the dura mater and pia mater, which are lost in the tissue to which the nerves are distributed. The nerves ramify in the pituitary membrane, and form tufts of filaments that communicate freely with the contiguous twigs, forming a network.

Structure.

The olfactory nerve differs in structure from the other cranial nerves; its divisions are deficient in the white substance of Schwann, and are nucleated and granular in texture. They resemble the gelatinous fibres in appearance, and seem to be formed of an extension of the nervous matter of the olfactory bulb. — (Todd and Bowman.*)

The other branches of nerves and arteries which are found in the nose will be described in the following section.

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* See Physiological Anatomy, &c., part third, p. 9. By R. B. Todd, M.D. and W. Bowman, London.

SECTION XIV.

SPHENO-PALATINE AND OTIC GANGLIA, FACIAL AND NASAL NERVES, AND BRANCHES OF THE INTERNAL MAXILLARY ARTERY.

Dissection of Meckel's ganglion.—FROM the ganglion of Meckel in the spheno-maxillary fossa, branches are furnished to the nose through the spheno-palatine foramen, to the palate through the canals of the same name, and to the facial nerve along the vidian canal. The position of these several nerves may first be ascertained by examining their apertures of transmission in the skull. Dissection of Meckel's ganglion;

To find the branches of the ganglion that enter the nose, take the left part of the sawn skull, and seek them opposite the spheno-palatine foramen, through which they enter the nasal fossa. One of these nerves (naso-palatine), before referred to as lying in the membrane of the septum, is to be isolated from the pituitary membrane, and followed forwards to where it enters the floor of the nose. Branches of the internal maxillary artery accompany the nerves, and are to be dissected. of its branches to the nose,

To expose the nerves that descend to the palate, take away the piece of mucous membrane that clothed the septum of the nose, as well as that lining the posterior part of the nasal fossa behind the spongy bones. After this covering is removed, the palatine nerves and vessels are seen through the thin ascending plate of the palate bone, and will be readily reached by breaking through the bone with a chisel. Afterwards, open the tube of membrane that contains the vessels and nerves, and follow these down to the soft palate and roof of the mouth, and onwards towards the incisor teeth. The palatine nerves lead upwards to the ganglion, which is close to the body of the sphenoid bone. But to bring the ganglion fully into view, it will be necessary to saw through the projecting part of the sphenoid bone, to cut away pieces of the bones surrounding the hollow in which it lies, and to remove with care the enveloping fat and the periosteum. The ganglion is seen to be a small reddish-looking body, from which the vidian nerve passes backwards. of its branches to the palate. of the body of ganglion;

To trace backwards the vidian branch to the carotid plexus and the facial nerve, lay open the canal which contains it in the root of the pterygoid process; and in doing this be careful of the small pharyngeal branch of nerve and artery that are superficial to the of the vidian nerve.

vidian, and lie in the pterygo-palatine canal. At the back of the pterygoid canal, seek a small branch from the vidian to the carotid plexus. Lastly, follow back the nerve into the skull by cutting away the point of the petrous part of the temporal bone and the internal carotid artery, and pursue it in its course on the surface of the temporal bone, beneath the ganglion of the fifth nerve, to the hiatus Fallopii. Its junction with the facial nerve will be seen with the dissection of that nerve. It is rather a troublesome task to trace the nerve through the cartilage in the foramen lacerum medium basis cranii.

Ganglion of Meckel. The SPHENO-PALATINE GANGLION (ganglion of Meckel) occupies the spheno-maxillary fossa close to the spheno-palatine foramen, and is connected with the palatine branches of the superior maxillary nerve. The ganglionic mass is somewhat triangular in form, and of a greyish colour. It is situate behind the branches of the superior maxillary nerve to the palate, and surrounds only part of their fibres; but it is prolonged posteriorly into the vidian nerve. Meckel's ganglion resembles the other ganglionic masses of the fifth nerve in having sensory, motor, and sympathetic filaments or roots connected with it, and in this wise:—sensory nerve fibres join it with the fifth nerve, motor fibres unite it with the facial nerve through the vidian branch, and sympathetic fibres in the sheath of the vidian connect it with the carotid plexus.

Situation and connection with spheno-palatine branches.

Structure.

Branches given The *branches* of the ganglion are directed upwards to the orbit; downwards to the mouth; inwards to the nose; and backwards to the pharynx, and to the facial and sympathetic nerves.

to the orbit, 1. *Branches to the orbit.*—These are two or three in number, and they ascend through the spheno-maxillary fissure, to end in the periosteum. It will be necessary to cut through the sphenoid bone to follow these nerves to their termination.

to the palate. 2. *Branches to the palate.*—The nerves of the palate, though connected in part with the ganglionic mass, are the continuation of the spheno-palatine branches of the superior maxillary nerve (p. 96.). Below the ganglion they are divided into three palatine nerves (large, small, and external), which are distributed to the roof of the mouth, the soft palate and tonsil, and the lining membrane of the nose.

are three.

Large has branches to nose

a. The *large palatine nerve* (anterior) reaches the roof of the mouth through the largest palatine canal, and extends forwards nearly to the incisor teeth, where it joins the naso-palatine nerve. Whilst in its canal the nerve furnishes two or more filaments (*inferior nasal*) to the membrane on the middle and lower spongy bones; and in the roof of the mouth it supplies the mucous membrane and glands, as well as an offset to the soft palate.

small, and

b. The *small palatine nerve* (posterior) lies in the smaller canal, and ends inferiorly in the soft palate and the levator palati muscle, the uvula, and the tonsil.

external palatine.

c. The *external palatine nerve* is smaller than the other two, and descends in the canal of the same name. Leaving the canal the nerve is distributed to the velum palati and the tonsil.

Nasal branches are

3. *Branches to the nose.*—The nasal branches, from three to five in number, are for the most part very small and soft, and pass inwards through the spheno-palatine foramen. One of these is the naso-palatine nerve. Their distribution is mentioned below.

Superior nasal,

a. The *superior nasal branches* (anterior) are distributed in the mucous membrane on the two upper spongy bones, and a few filaments reach the back part of the septum narium.

Naso-palatine.

b. The *naso-palatine nerve* (nerve of Cotunnius) crosses the roof of the nasal fossa to reach the septum nasi, and descends on it to near the front. The nerve now enters a special canal, by the side of the septum, that of the left side of the body being anterior to the other, and is conveyed therein to the roof of the mouth, where it lies in the centre of the anterior palatine foramen. Finally, the nerves of opposite sides are united in the mouth, and are distributed in the mucous membrane behind the incisor teeth; at their distribution they are connected with the great palatine nerves. On the septum narium filaments are supplied by the naso-palatine nerve to the mucous membrane. To follow the nerve to its termination the canal in the roof of the mouth ought to be opened.

Branches backwards are

4. The *posterior branches* are two: a pharyngeal branch, and the vidian nerve.

to pharynx

a. The *pharyngeal branch* is very small, and is directed through the pterygo-palatine canal to the mucous membrane of the pharynx near the Eustachian tube, in which it ends.

and the facial and sympathetic nerves through the vidian.

b. The *vidian nerve* passes backwards through the vidian canal, and sends some small filaments through the bone to the membrane of the back part of the roof of the nose (*upper posterior nasal branches*). At its exit from the canal the nerve furnishes a soft reddish offset (*carotid branch*) to join the sympathetic on the outer side of the carotid artery. The continuation of the nerve enters the cranium through the cartila-

ginous substance closing the foramen lacerum medium basis cranii, and is directed backwards in a groove on the surface of the petrous part of the temporal bone, where it takes the name *large superficial petrosal nerve.* Lastly it is continued through the hiatus Fallopii, to join the gangliform enlargement on the facial nerve. Whilst in the temporal bone the vidian receives a twig from the tympanic nerve.

Vidian a compound nerve. The vidian nerve may be supposed to consist of motor and sympathetic fibres in the same sheath, which are combined here in the same manner as in the connecting branches between the sympathetic and spinal nerves.

Seek other nerves and vessels of nose. *Dissection.*—The student may now direct his attention to the remaining nerves and vessels that have been exposed by the previous dissections. The nasal nerve is to be sought in the nose behind the nasal bone, by gently detaching the lining membrane, and cutting off the projecting bone. A branch is given from the nerve to the septum, but probably this and the trunk of the nerve will be seen but imperfectly in the present condition of the part. The terminal branches of the internal maxillary artery in the spheno-maxillary fossa are to be completely traced out.

Nasal nerve The *nasal nerve* (of the ophthalmic) has already been seen in its course in the orbit, and at its termination in the face (p. 42.); and the part that connects the two through the nose is now to be learned. lies beneath nasal bone; gives Entering the nasal fossa by an aperture in the front of the ethmoid bone, the nerve gives a branch to the septum narium, and is then continued in a groove behind the os nasi to the lower margin of that bone, where it escapes to the surface of the nose.

branch to septum *Branches.*—The *branch to the septum* divides into filaments that ramify on the anterior part of that partition, and reach nearly to the lower part.

and to outer wall. *One* or *two filaments* are likewise furnished by the nerve to the fore part of the outer wall of the nasal fossa; these extend as low as the inferior spongy bone.

Branches of internal maxillary artery are *Terminal branches of the internal maxillary artery.*—The branches of the artery in the spheno-maxillary fossa, which have not been examined, are the following:—superior palatine, naso-palatine, pterygo-palatine, and vidian.

palatine branch, 1. The *superior* or *descending palatine* is the largest branch of the artery in the fossa, and accompanies the large palatine nerve in its canal. Arrived at the palate, the vessel is directed forwards in the roof of the mouth, and anastomoses behind the incisor teeth, with the artery of the opposite side, and with a branch that descends from the nose through the anterior palatine canal. In its

course the artery supplies branches to the other palatine canals, which pass with the contained nerves to the soft palate and tonsil, and some offsets are furnished to the lining membrane of the nose. In the roof of the mouth the mucous membrane, glands, and gums receive their branches from this artery.

2. The *nasal* or *spheno-palatine artery* enters the nose through the spheno-palatine foramen, and divides into branches. Some of these are distributed on the spongy bones and the outer wall of the nasal fossa, and supply offsets to the membrane lining the posterior ethmoid cells. One long branch, artery of the septum (*art. naso-palatina*), runs on the partition between the nostrils to the anterior palatine canal, through which it anastomoses with the superior palatine in the roof of the mouth. This branch accompanies the naso-palatine nerve, and covers the septum with numerous ramifications. nasal branches, one to septum nasi,

3. The *pterygo-palatine* is a very small branch, which passing backwards through the canal of the same name, is distributed to the Eustachian tube and the lining membrane of the pharynx. pterygo-palatine branch,

4. The *vidian* or *pterygoid branch* is contained in the vidian canal with the nerve of the same name, and, escaped from the canal, ends on the upper part of the pharynx, and the Eustachian tube. vidian branch.

Some other small *nasal arteries* are furnished by the anterior and posterior ethmoidal branches (of the ophthalmic), and by the facial artery near the nostril. Other nasal arteries.

Dissection of the facial nerve in the temporal bone. — To render this dissection easier, the student should be provided with a temporal bone, in which the course of the facial nerve and the cavity of the tympanum are exposed. Begin the examination of the nerve at the stylo-mastoid foramen. With this view saw through the side of the skull between the meatus externus and the anterior border of the mastoid process, so as to open the posterior part of the aqueduct of Fallopius. The nerve will then be seen entering deeply into the substance of the temporal bone; and to follow it, the dissector must cut away with the bone forceps all the bone projecting above it. In this last step, the cavity of the tympanum will be more or less opened, and the chain of bones in it exposed. Trace onwards the nerve along the inner side of the tympanum till it becomes enlarged and bends suddenly inwards to the meatus auditorius internus. Remove the surrounding bone from the enlargement on the nerve, tracing to it the large superficial petrosal nerve, and then lay open the meatus auditorius to see the facial and auditory nerves in that hollow. Dissection of facial nerve in bone,

of chorda tympani, The course of the chorda tympani nerve (branch of the facial) across the tympanum will be exposed by the removal of the incus. The nerve may also be traced through the wall of the cavity behind, as well as out of the cavity in front.

and other branches. The remaining branches of the facial nerve in the bone are very minute, and are not to be seen, unless on a fresh piece which has been softened in acid. The student may therefore omit all the paragraphs marked with an asterisk till he is able to obtain a part on which a minute examination can be made.

Facial nerve. The *facial nerve* has been seen in the base of the skull to enter the internal auditory meatus with the auditory nerve, with which it is connected. The nerve is then received into the aperture of the aqueduct of Fallopius in the bottom of winds through temporal bone, the meatus, and is conducted through the temporal bone to the stylo-mastoid foramen and the face (p. 36.). In its serpentine course through the bone, the nerve is first directed inwards to the inner wall of the tympanum: at that spot it is marked by swelling, which receives many twigs. suddenly bends backwards, and is marked by a gangliform swelling (intumescentia gangliformis) to which several nerves are united. From this swelling the nerve is continued through the arched course of the aqueduct, viz. along the upper part of the inner wall of the tympanum, and then behind that cavity to the aperture of exit from the bone. The branches of the nerve in the bone serve to connect it with other nerves.

Branches joining nerve *Connecting branches.*—These branches communicate with the auditory, vagus, and glosso-pharyngeal nerves; also with two divisions of the fifth nerve (superior and inferior maxillary).

to auditory nerve, * *a. Union with the auditory nerve.*— In the bottom of the meatus the facial and auditory nerves are connected by one or two minute filaments.

to superior maxillary, tympanic, and sympathetic, * *b. Connecting branches of the gangliform enlargement.*—The swelling of the facial nerve receives three small twigs. One in front is the *large superficial petrosal* nerve (vidian); another is the *small superficial petrosal* of the tympanic nerve; and the third is the *external superficial petrosal*, which is derived from the sympathetic on the middle meningeal artery.

to auricular branch of vagus, * *c. Filaments of the auricular branch of the pneumogastric* join the trunk of the facial nerve, near the stylo-mastoid foramen, the auricular branch crossing the other at that spot in its course to the ear.

d. Chorda tympani.—This long but slender branch of the facial nerve crosses the tympanum, and becomes united with the gustatory nerve near the skull. Arising about a quarter of an inch from the stylo-mastoid foramen, the nerve is directed forwards to the tympanum through a canal in its posterior boundary, and enters that cavity below the pyramid. In the cavity the nerve is enlarged by a covering of the lining membrane, and is directed forwards across the handle of the malleus and the membrana tympani to an aperture on the inner side of the Glasserian fissure, through which it leaves the tympanum. Outside the skull the chorda tympani descends to the gustatory nerve (see p. 88.). to gustatory by chorda tympani.

The AUDITORY NERVE will be examined with the ear. It may now be seen to divide into two parts, one of which enters the cochlea, and the other the vestibule. Auditory nerve.

Dissection of the otic ganglion.—At this late period of the dissection, there is little to be seen of the ganglion, but the student should remember that it is one of the things to be examined in a fresh part. Its situation is on the inner aspect of the inferior maxillary nerve, close to the base of the skull, and it must therefore be arrived at from the inner side. Putting the part in the same position as for the examination of Meckel's ganglion, define the Eustachian tube and the muscles of the palate, and then take away the levator palati and the tube, using much care in removing the last. When some cellular membrane is cleared away, the internal pterygoid muscle is exposed, with the trunk of the inferior maxillary nerve above it, and a small branch (internal pterygoid) descending to the surface of the muscle. If the dissector traces up this branch of nerve of the pterygoid muscle, he will be led to the ganglion. Dissection should be repeated on a fresh part.

* To complete the dissection, saw vertically through the petrous part of the temporal bone, a little nearer the middle line than the inner wall of the tympanum, the bone being supported whilst it is divided. Taking off now some membrane that covers the ganglion, follow backwards a small branch to the tensor tympani muscle, and open the small canal that contains the muscle by entering it from below through the carotid canal. Above this small branch is another minute nerve (small superficial petrosal nerve) that issues from the skull, and joins the back of the ganglion. A small twig is to be sought from the front of the ganglion to the tensor palati muscle, and another to join the sympathetic nerve on the middle meningeal artery. To define ganglion and its branches.

Otic ganglion is on inner side of inferior maxillary.

The OTIC GANGLION (gang. auriculare, Arnold) resembles the other ganglia connected with the fifth nerve. It is a small reddish body, which is situate on the inner aspect of the inferior maxillary nerve close to the skull, and surrounds the origin of the branch of nerve to the internal pterygoid muscle. By its inner surface the ganglion is in contact with the Eustachian tube, and at a little distance behind is seen the middle meningeal artery. In this ganglion, as in the others above referred to, filaments from motor, sensory, and sympathetic nerves are blended. Some twigs are furnished by it to muscles.

Structure.

Branches join it with fifth, sympathetic, and tympanic nerves.

**a*. *Connecting branches — roots.* — The ganglion is joined by a fasciculus from the motor part of the inferior maxillary nerve, and is closely united with the nerve of the internal pterygoid muscle, thus receiving two of its roots, motor and sensory, from the fifth nerve. Its connection with the sympathetic is established by a twig received from the plexus on the middle meningeal artery. Further, the ganglion is connected with the tympanic nerve by means of the small superficial petrosal nerve that joins the posterior part.

Other branches enter muscles.

**b*. *Branches of distribution.*—Two muscles receive their nerves from the otic ganglion, viz. tensor tympani and circumflexus palati. The nerve of the tensor tympani is directed backwards, and enters the bony canal that contains that muscle. The branch of the circumflexus, arising from the front of the ganglion, may be supposed to be derived from the internal pterygoid nerve.

Nerve of internal pterygoid.

The *nerve of the internal pterygoid muscle* is a long slender branch, that arises from the inner side of the inferior maxillary nerve near the skull, and is directed downwards to the deep surface of the muscle. This nerve is joined by a fasciculus from the motor part of the fifth nerve.

The dissection of the left pterygo-maxillary region may be again repeated on this side of the body.

SECTION XV.

THE TONGUE.

Dissection.

Dissection. — Take the tongue with the larynx still attached to it, to examine its general form. The ends of the lingual muscles may be cut off, but enough of each should be left to trace it afterwards into the substance of the tongue.

The TONGUE occupies the interior of the mouth, and is retained in its position by the muscles and the mucous membrane that are attached to the under surface. It is somewhat pyramidal in form, and increases in thickness from before backwards. Tongue. Situation and form.

The apex or tip of the tongue is in contact with the incisor teeth; whilst the base looks towards the pharynx, and is connected with the epiglottis by three folds of mucous membrane. The upper surface or dorsum of the tongue is somewhat convex, and is received into the hollow of the roof of the mouth; it is divided into two equal parts by a median groove, which is less marked towards the posterior part of the tongue, and ends oftentimes in a hollow named foramen cæcum. This aspect is studded with numerous papillæ, and near the posterior part are some lingual glands. The under surface gives attachment to the mucous membrane, and to the different lingual muscles. The borders of the tongue are thick and round at the base of the organ, but gradually become thinner near the apex. Connections of apex, base. Upper surface. Under surface. Borders.

Papillæ.—There are the following kinds of papillæ on the dorsum of the tongue; the conical and filiform, the fungiform, and the caliciform. Kinds of papillæ;

a. The *conical* and *filiform* papillæ are numerous small points that cover the surface of the tongue, like the villi on the mucous membrane of the small intestine, and gradually cease near its base. Some of the papillæ (conical) are wider at their attachment than at the free end, and are most developed at the central part of the tongue. Other sbecome longer (filiform), especially towards the sides of the tongue. These small papillæ are covered with secondary minute processes. conical and filiform, situation in middle of tongue;

b. The *fungiform* papillæ are less numerous but larger than the preceding set, amongst which they are scattered. They are wider at the free end than at the tongue, and project beyond the other set; they are mostly situate at the tip and sides of the tongue. The free or larger end is covered with small filamentous projections. fungiform mostly at tip and sides;

c. The *caliciform* (papillæ vallatæ) are fewer in number and larger than the others, and are placed near the root of the tongue. Their number varies from eight to fifteen. These papillæ extend across the tongue in a line resembling the letter V. Each papilla caliciform near root of tongue;

form consists of a central truncated part of a conical form, which is surrounded by a fold of the mucous membrane. Its wider part or base projects above the surface, whilst the apex is attached to the tongue. Both the papilla and the surrounding fold are furnished with smaller secondary papillæ.

is marked by other papillæ.

Secondary papillæ. Secondary papillæ exist between the larger kinds as well as in the part of the tongue behind the caliciform kind; but they are not observed till the epithelium is removed. — (Todd and Bowman.)

Structure of papillæ. *Structure of the papillæ.* — Each papilla contains one or more vascular loops, and a nervous filament. Investing the whole is a layer of laminar epithelium, which is most marked on the filiform papillæ. On the papillæ this covering gives rise to minute points resembling hairs.

Dissection of muscles and nerves. *Dissection.* — Place the tongue on its dorsum and dissect out the different muscles that enter into it, and expose the septum of the tongue along the middle line. The glosso-pharyngeal nerve is to be traced into the lingual substance both on the dorsum and on the under surface. The gustatory and hypo-glossal nerves may likewise be followed further into the tongue, the ramifications of the former reaching the papillæ.

Parts found in tongue. STRUCTURE. — The tongue consists chiefly of muscular fibres, in which some fatty substance is scattered; and a fibrous septum occupies the middle line. Entering it are the lingual vessels and nerves, and connected with these are the papillæ on the upper surface. The whole is enveloped by the mucous membrane.

A fibrous incomplete septum. The *fibrous septum* is seen in the middle line of the tongue, between the genio-hyo-glossi muscles. It is strong posteriorly, where it is fixed to the hyoid bone, and gradually ceases as it extends forwards. To its sides are attached the muscular fibres. A thin piece of fibro-cartilage is sometimes present in the septum.

External muscles of the tongue. MUSCLES. — In each half of the tongue are the terminations of its extrinsic muscles, viz. stylo-glossus, hyo-glossus, palato-glossus, and genio-hyo-glossus. The fibres of the stylo-glossus are directed forwards along the border of the tongue; and internal to these are the fibres of the palato-glossus and hyo-glossus, which mix with them. In the middle line, from base to apex, are implanted the vertical fibres of the genio-hyo-glossus. These muscles have been

already examined, and their description will be found at page 91.

Besides these external muscles, there are the following special or intrinsic muscles of the tongue: — Special muscles.

Inferior lingualis. — Between the stylo-glossus and genio-hyo-glossus of the tongue is the fleshy fasciculus of the large or inferior lingualis muscle. It *arises* posteriorly at the base of the tongue; and its fibres, which are longitudinal, join those of the hyo-glossus and stylo-glossus, and reach forwards to the tip of that organ, where they terminate. A considerable part of each half of the tongue is constituted by this muscle. Inferior lingualis forms great part.

Superior lingualis. — When the mucous membrane is removed from the dorsum of one half of the tongue, a thin layer of superficial longitudinal fibres will be exposed (lingualis longitudinalis superior). This begins by thin fibres at the root of the tongue, and extends to the tip: the fibres are best marked about the middle or near the end of the tongue, but they do not reach the whole length of the organ. Superior lingualis is small in size.

The *transversalis muscle* will be seen by removing the fibres of the upper and lower longitudinal muscles, to form the chief part of the half of the tongue, external to the genio-hyo-glossus. Its fibres *arise* externally from the border and dorsum of the tongue, and end along the middle line; or *vice versâ*. The anterior fibres are continuous with the muscle of the opposite side, whilst those farther back are curved upwards, are mingled with the genio-hyo-glossus, and are inserted into the fibrous septum. Transversalis muscle forms most of the half of the tongue.

The *mucous membrane* of the tongue is a continuation of that lining the mouth, and is provided with a laminar epithelium. Like the membrane of the mouth it is furnished with numerous muciparous glands, and some follicles. The *follicles* are seen on the surface, and are either single or collected in patches. Mucous membrane; its epithelium and follicles;

The *glands* (lingual) are compound in structure, similar to those of the lips and cheek, and are placed beneath the mucous membrane covering the posterior third of the dorsum and the borders of the tongue. Some of their ducts open into the foramen cæcum. Under the tip of the tongue, on each side of the frænum, is a collection of the same kind of glands, from which several ducts issue. and glands at the base and beneath tip.

Nerves from three sources, NERVES.—There are three nerves to each half of the tongue, the gustatory, the hypo-glossal, and the glosso-pharyngeal.

gustatory, ninth, and glosso-pharyngeal. The *gustatory nerve* gives upwards filaments to the muscular substance, and to the two smallest sets of papillæ, conical and fungiform; it also joins the hypo-glossal nerve. The *hypo-glossal nerve* is spent in long slender filaments that are furnished to the muscular substance of the tongue. The *glosso-pharyngeal* nerve divides into two branches near the border of the tongue. One turns to the dorsum of the tongue, and ends in the mucous membrane near the base. The other passes beneath the tongue, and divides into filaments that enter the muscular substance, and supply the papillæ caliciformes, as well as the mucous membrane covering the part of the tongue behind those papillæ.

Arteries and veins. VESSELS.—The arteries are derived chiefly from the lingual artery of each side; these, together with the veins, have been examined, p. 92. After supplying the muscular substance the vessels enter the papillæ, forming a loop or loops in the interior, according to their size.

SECTION XVI.

THE LARYNX.

Dissection. *Dissection.*—CUT through the root of the tongue, and remove it from the larynx, but without injuring the epiglottis. The parts that are now to be described would be much better seen on a fresh larynx.

Outline of larynx. The LARYNX is the upper dilated part of the air tube, in which the voice is produced. This organ is pyramidal in shape, with the base uppermost, and consists of several cartilages, which are united together by ligamentous bands; of muscles to move the cartilages; and of vessels and nerves. The whole is lined by mucous membrane.

Situation and connections. Occupying the middle line of the neck, the larynx is in front of the pharynx, and between the carotid vessels. Superiorly it is attached to the hyoid bone, and inferiorly it is continuous with the trachea. To the upper part the epiglottis is attached. The front is prominent along the middle line of the neck; and the posterior aspect is covered

by the mucous membrane of the pharynx. The larynx is very moveable, and during deglutition is elevated and depressed by the different extrinsic muscles connected with it and the hyoid bone. Is very moveable.

MUSCLES. — The special muscles of the larynx pass from one cartilage to another, and modify by their action the condition of the glottis. Commonly there are six muscles described, but the number is stated differently by anatomists. Three are outside the cartilages, viz. crico-thyroid, posterior crico-arytænoid, and arytænoid. Three are more or less concealed by the thyroid cartilage, and are the lateral crico-arytænoideus, the thyro-arytænoideus, and the arytæno-epiglottideus. Six special muscles of larynx.

Dissection. — On one side of the larynx, say the right, the muscles are to be dissected, and on the opposite side the nerves and vessels. Extend the larynx, and when it is fastened in that state with pins, clear away from the os hyoides and the thyroid cartilage the following extrinsic muscles that are inserted into them, viz. the constrictor, sterno-hyoid, sterno-thyroid, and thyro-hyoid. Between the thyroid and cricoid cartilages in front the dissector will see one of the three small external muscles, crico-thyroid. The other two external muscles are situate at the posterior aspect of the larynx: to expose them it will be necessary to turn over the larynx, and to remove the mucous membrane covering it. On the back of the cricoid cartilage the dissector will find the crico-arytænoideus posticus muscle of each side; and above these, on the posterior part of the arytænoid cartilages, the arytænoid muscle will be seen. Dissection. of the external set of muscles.

The CRICO-THYROID MUSCLE is triangular in form, and is separated by an interval from the one of the opposite side. It *arises* from the side of the cricoid cartilage, and its fibres ascend, diverging from one another, to be *inserted* into the small cornu and the lower border of the thyroid cartilage, also for a short distance into the inner surface of the same. The muscle rests on the crico-thyroid membrane, and is concealed by the sterno-thyroid muscle. Crico-thyroideus is small.

The CRICO-ARYTÆNOIDEUS POSTICUS MUSCLE lies on the posterior part of the cricoid cartilage. Its *origin* is from the depression on the side of the vertical ridge at the pos- Crico-arytænoideus posticus

is on back of cricoid cartilage. terior aspect of that cartilage. From this origin the fibres are directed outwards, and converge to be *inserted* into the outer part of the base of the arytænoid cartilage.

Arytænoideus The ARYTÆNOIDEUS is a single muscle in the middle line, and is placed in the concavity on the posterior aspect of the arytænoid cartilages, to which it is attached. Two sets of fibres with different directions are seen in the muscle. The superficial fibres consist of two oblique fasciculi, which cross like the parts of the letter X, each passing from the base of one cartilage to the apex of the other. The deep fibres are transverse, and are inserted into the outer border and the posterior surface of the cartilages; they close the interval between the cartilages. A few of the oblique fibres of the muscle are usually continued round the cartilage to join the thyro-arytænoid muscle, or the fibres in the arytæno-epiglottidean fold of mucous membrane.

has superficial or oblique, and deep or transverse fibres.

Dissection of internal muscles. *Dissection.*—To expose the remaining muscles which are somewhat concealed by the thyroid cartilage, remove the right half of the cartilage by cutting it through near the middle line, after its small cornu has been detached from the cricoid cartilage. By the removal of a little cellular membrane the dissector will expose inferiorly the lateral crico-arytænoid muscle; above it, the thyro-arytænoideus muscle; and still higher, the thin muscular fibres in the fold of mucous membrane between the epiglottis and the arytænoid cartilage.

Lateral crico-arytænoideus The CRICO-ARYTÆNOIDEUS LATERALIS *arises* from the lateral part of the upper border of the cricoid cartilage; and its fibres are directed backwards to be *inserted*, with the thyro-arytænoid muscle, into the projection on the outer side of the base of the arytænoid cartilage. This muscle is concealed by the crico-thyroideus, and its upper border is contiguous to the succeeding muscle.

is beneath thyroid cartilage.

Thyro-arytænoideus. The THYRO-ARYTÆNOIDEUS MUSCLE extends backwards in the interior of the larynx from the thyroid to the arytænoid cartilage; it is thick below, but thin and expanded above. The muscle *arises* from the thyroid cartilage near the middle line, for about the lower third of its depth. The fibres are directed backwards, with different directions; the external ascend somewhat, and are inserted into the upper part of

Some fibres ascend to tip,

the arytænoid cartilage on its outer aspect; but the internal and lower fibres are transverse, and form a thick bundle, which is inserted into the anterior part of the base of that cartilage, as well as into the outer surface, and some fibres are attached to the vocal cord. By its outer aspect the muscle is in contact with the thyroid cartilage; and the inner surface rests on the vocal cords, and on the ventricle of the larynx and its pouch. others go to base of arytænoid cartilage. Connections.

The DEPRESSOR OF THE EPIGLOTTIS (reflector epiglottidis, thyro-arytæno-epiglottideus) is the thin muscular layer, which is contained in the fold of mucous membrane that bounds laterally the opening of the larynx. Its fibres *arise* posteriorly from the front of the arytænoid cartilage, some being continuous with the oblique fibres of the arytænoid muscle, and a fasciculus (thyro-epiglottideus) is attached anteriorly to the inner surface of the thyroid cartilage. From this origin the fibres turn upwards with very different directions, and are *inserted* into the border of the epiglottis. The strength of this muscle varies much in different bodies. Depressor of epiglottis double origin. Insertion.

INTERIOR OF THE LARYNX.—Within the space enclosed by the laryngeal cartilages are the parts more immediately concerned in the production of the voice, viz. the vocal cords, the glottis, and the ventricle of the larynx and its pouch. Parts inside larynx.

Dissection.—Open the tube of the larynx by dividing it along the posterior part; and in cutting through the arytænoid muscle let the incision be rather to the right of the middle line, to avoid the nerves that enter it. On looking into the larynx a depression (ventricle) is seen on each side; and if a probe is passed into this hollow it will be found to enter a small pouch by an aperture in the anterior part. The dissector is to fill the pouch on the right side by introducing very small round bits of cotton wool into it. Dissection to expose them.

The *space* in the inside of the larynx reaches from the superior aperture to the lower border of the cricoid cartilage. In the recent state of the parts, the large interval between the alæ of the thyroid cartilage is much diminished in size by the thyro-arytænoid muscles and ligaments, so that only a narrow interval, the glottis, is left at one spot. Above the Space partly filled. producing glottis.

glottis, on each side, is the lateral hollow of the ventricle of the larynx. The rest of the space remains of the same shape and size as the cricoid cartilage, and is therefore circular, and larger than the narrow part before alluded to.

The rest large.

Upper orifice, shape, and boundaries.

The *upper orifice* of the larynx will be seen by placing in contact the cut surfaces. It is triangular in shape, with the base in front and the apex behind, and its sides are sloped obliquely downwards, in the antero-posterior direction. Its boundaries are,—the epiglottis in front, the arytænoid muscle and cartilages behind, and the arytæno-epiglottidean fold of mucous membrane on each side. This aperture is closed by the epiglottis during deglutition.

Glottis. Situation, form, and size.

The *glottis*, or the fissure between the lower vocal cords, is the narrowest part of the cavity of the larynx. It is triangular in form, like the upper orifice, but its wider part is posteriorly at the interval between the arytænoid cartilages. Its measurement from before backwards is about an inch, whilst the base is about a third of that size. In the female, the length is less.

Ventricle. Situation. Parts around.

The *ventricle* of the larynx is the oval hollow above the vocal cord on each side. The upper margin of the opening is semilunar, and the lower is straight. On the outer surface are the fibres of the thyro-arytænoid muscle, and in the anterior part is the aperture into the laryngeal pouch.

Pouch of larynx. Form and position. Surrounding parts.

The *laryngeal pouch* (sacculus laryngis) will be best seen by removing, still on the right side, the thyro-arytænoid muscle. It is a small membranous sac, half an inch deep, and cylindrical in form, which projects upwards between the thyro-arytænoid muscle and the upper thyro-arytænoid ligament, and reaches as high as the upper border of the thyroid cartilage. Its cavity communicates with the front of the ventricle by a narrow aperture, provided with two folds of mucous membrane. On the outer surface are numerous small glands, whose ducts are transmitted through the coats of the sac to the inside. Numerous nerves are also distributed over the sac.

Dissection.

Dissection.—Remove the mucous membrane on the right side from the two whitish bands, thyro-arytænoid ligaments, that bound the ventricle of the larynx. Then take away the lateral

crico-arytænoid muscle, and any fibres that may remain of the thyro-arytænoideus.

The *thyro-arytænoid ligaments* are two bands on each side, which are extended from the angle of the thyroid to the arytænoid cartilage, one forming the upper, the other the lower margin of the ventricle.

Thyro-arytænoid ligaments.

a. The *inferior one* (chorda vocalis) is a strong band of elastic tissue, which is almost transverse in direction. Attached, in front, to the angle of the thyroid cartilage, about half way down, the fibres of the ligament are directed backwards, and are inserted into the anterior projection at the base of the arytænoid cartilage. Internally, this band is free in the cavity of the larynx, the interval between it and the opposite one being the glottis; externally, it is covered by the thyro-arytænoid muscle; and inferiorly it is continuous, near the arytænoid cartilage, with the crico-thyroid membrane.

Inferior or vocal cord

has these connections.

b. The *upper ligament* (false vocal cord) is semilunar in form, and is much weaker than the preceding one. It is fixed in front to the angle of the thyroid cartilage, near the attachment of the epiglottis; and behind to the anterior border of the arytænoid cartilage. This ligament contains some fibrous tissue in its structure, which is continuous with that in the arytæno-epiglottidean fold of mucous membrane.

Upper ligament

is a very slight band.

The *mucous membrane* of the larynx is prolonged to the lungs through the trachea. When entering the larynx it is stretched between the epiglottis and the tip of the arytænoid cartilage, forming the arytæno-epiglottidean fold on each side of the laryngeal orifice. In this part it is very loose, and the submucous tissue abundant. In the larynx the membrane closely lines the cavity, sinks into the ventricle, and is prolonged into the laryngeal pouch. On the thyro-arytænoid ligaments it is very thin and adherent, allowing these to be visible through it.

Mucous membrane.

A *columnar ciliated epithelium* covers all the surface below the superior vocal cords, and is continued anteriorly to the posterior aspect of the epiglottis as far as its middle. In the part of the larynx above the line mentioned, the epithelium is of the laminar kind. Numerous *muciparous glands* are connected with the mucous membrane of the larynx; and their orifices will be seen on the surface, especially at the posterior aspect of the epiglottis. In the

Epithelium

has different texture.

Glands.

edge of the arytæno-epiglottidean fold there is a little swelling occasioned by a mass of subjacent glands (arytænoid) and a small fibro-cartilaginous body. None exist over the vocal cord.

Nerves are from vagus.

NERVES.— The nerves that supply branches to the larynx are the superior and inferior laryngeal branches of the pneumo-gastric nerve; the former is distributed to the mucous membrane, and the latter to the muscles.

Dissection.

Dissection.— The course of the laryngeal nerves in the neck has been already traced, and their termination in the larynx is to be dissected on the untouched side. For this purpose disarticulate the other half of the thyroid from the cricoid cartilage, and take care of the recurrent nerve which lies near the junction between the two. Fasten down the trachea and larynx with pins, and draw the thyroid away from the cricoid cartilage. Now trace the inferior laryngeal nerve over the side of the cricoid cartilage to the muscles of the larynx and to the mucous membrane of the pharynx. Afterwards the superior nerve is to be followed to the mucous membrane of the interior of the larynx and to that of the pharynx. Two communications are to be found between these nerves; one is beneath the thyroid cartilage, the other in the mucous membrane of the pharynx. An artery accompanies each nerve.

Recurrent nerve supplies special muscles except one.

a. The *inferior laryngeal* nerve (recurrent), when about to enter the larynx, furnishes backwards an offset to the mucous membrane of the pharynx, which joins with filaments from the upper laryngeal nerve. The nerve then passes beneath the ala of the thyroid cartilage, and ends in branches for the different special muscles of the larynx, except the crico-thyroideus. Its small muscular branches are easily followed, but that to the arytænoid muscle passes beneath the crico-arytænoideus posticus. Beneath the thyroid cartilage this nerve is joined by a long offset of the upper laryngeal nerve.

Superior laryngeal nerve joins recurrent, and ends in mucous membrane.

b. The *superior laryngeal* nerve pierces the thyro-hyoid ligament, and gives offsets to the mucous membrane covering the back of the larynx; it also furnishes a long branch beneath the ala of the thyroid cartilage to communicate with the recurrent nerve. The trunk of the nerve then terminates in many branches for the supply of the mucous membrane. Some of these ascend in the arytæno-epiglottidean fold of that membrane to the epiglottis, and to the root of the tongue. The others, which are the largest, descend on the inner side of the ventricular pouch, and supply the lining membrane of the larynx as low as the chorda vocalis. One

nerve of this set pierces the arytænoid muscle, and appears to supply it.

VESSELS.—The arteries of the interior of the larynx are furnished from the superior and inferior thyroid trunks. Arteries,

a. The *laryngeal branch* of the *superior thyroid artery* enters the larynx with the superior laryngeal nerve, and divides like it into ascending and descending branches; some of these enter the muscles, but the rest supply the mucous membrane of the epiglottis, that of the root of the tongue, and of the interior of the larynx. It anastomoses with the following artery both beneath the ala of the thyroid cartilage, and in the mucous membrane of the pharynx. from superior thyroid;

b. The *laryngeal branch* of the *inferior thyroid artery* ascends on the back of the cricoid cartilage, and supplies the mucous membrane of the pharynx and the muscles of the larynx, like the nerve. Some twigs, also, from the inferior thyroid artery perforate the crico-thyroid membrane, and end in the mucous lining of the interior of the larynx at the lower part. from inferior thyroid two sources.

Veins.—The vein that accompanies the branch of artery from the superior thyroid joins the internal jugular or the superior thyroid vein, whilst the vein corresponding to the other artery opens into the plexus connected with the inferior thyroid veins (p. 75. 114.). Veins end differently.

SECTION XVII.

HYOID BONE, CARTILAGES AND LIGAMENTS OF THE LARYNX, AND STRUCTURE OF THE TRACHEA.

Dissection.—To expose the hyoid bone, the cartilages of the larynx, and the epiglottis, let the dissector take away the muscles and the mucous membrane. In the arytæno-epiglottidean fold of mucous membrane a small fibro-cartilaginous body (cuneiform cartilage) should be sought. Dissection.

The *hyoid bone* (os hyoides) is situate between the larynx and the root of the tongue. Resembling the letter U, placed horizontally with the legs turned backwards, it offers for examination a central part or body, and two side pieces or cornua. Hyoid bone. Form.

The body is flattened, and measures most in the vertical direction. Convex in front, it presents an uneven surface for the attachment of muscles, whilst on the opposite aspect it is concave. To the upper border is attached the septum of the tongue. Body of the bone

Side pieces large

The cornua are two in number on each side (large and small). The *large* cornu continues the bone backwards, and is joined to the body of the os hyoides by a surface covered with cartilage. The surfaces of this cornu look somewhat upwards and downwards; and the size decreases from before backwards till it ends posteriorly in a tubercle. The *small* cornu, or appendix, is directed upwards from the point of union of the great cornu with the body, and is joined by the stylo-hyoid ligament. It is frequently cartilaginous.

and small.

There are four large

and some small cartilages.

CARTILAGES OF THE LARYNX. — There are four large cartilages in the larynx, which are concerned in the production of the voice, viz. the thyroid, the cricoid, and the two arytænoid. In addition, there is the fibro-cartilaginous epiglottis, together with some small rudimentary pieces in the arytæno-epiglottidean fold of mucous membrane.

Thyroid cartilage

is convex in front,

concave behind.

The *thyroid cartilage* forms the upper part of the larynx, and protects the vocal apparatus as with a shield. From the greater width of the upper part of this cartilage the form of the larynx somewhat resembles a funnel. The anterior part is prominent in the middle line (pomum Adami); but the cartilage is concave behind at the same part, and gives attachment to the epiglottis and the thyro-arytænoid muscles and ligaments. The upper border is notched in the centre.

Formed of two halves,

each having borders and cornua.

The cartilage is formed of two square parts or halves, which are united in the middle line. The inner surface of each half is smooth, but the outer is marked by an oblique line, that extends from a tubercle at the root of the upper cornu, nearly to the middle of the lower border. Posteriorly the half of the cartilage has a thick border, which terminates upwards and downwards in a rounded projection or cornu: of these two the upper cornu is the longest; but the lower cornu is thicker than the other, and articulates with the cricoid cartilage.

Cricoid cartilage.

Form.

The *cricoid cartilage* is stronger than the thyroid, below which it is placed, and encircles the cavity of the larynx. It is very unequal in depth before and behind, the posterior part being three times deeper than the anterior, something like a signet ring.

Surfaces.

The outer surface is flat and rather square at the back of the cartilage, and is marked by a median ridge, with two contiguous lateral depressions; and on the side of the cartilage is a slight articular surface which receives the lower cornu of the thyroid cartilage. The inner surface is smooth, and is covered by mucous membrane.

The lower border is nearly straight, and is united to the first ring of the trachea by fibrous membrane. But the upper border is irregular in its outline; for though it is straight posteriorly between the articular marks for the arytænoid cartilages, or in the part corresponding to the deeper piece of the ring, in front of that spot the border is sloped obliquely downwards to the middle line. The cricoid cartilage is somewhat overlaid on the sides by the thyroid cartilage. Borders, the upper most uneven.

The *arytænoid cartilages* are two in number, one on each side of the middle line, and are placed on the upper border of the cricoid cartilage, at the back of the larynx. Each cartilage is triangular in shape, and offers for examination a base, apex, and three surfaces. Arytænoid cartilages. Situation and form.

The base has a slightly hollowed surface for articulation with the cricoid cartilage, and is elongated by means of an anterior and a posterior process; the former gives attachment to the vocal cord, and the latter receives the insertion of the crico-arytænoid muscles. The apex is directed backwards and somewhat inwards, and is surmounted by the cartilage of Santorini. The inner surface is flat and even, but the outer is rough and excavated. At the posterior aspect the cartilage is concave and smooth. Base. Apex. Three surfaces.

Cartilages of Santorini.— Attached to the apex of each arytænoid cartilage is a small conical cartilage (cornicula, capitula Santorini), which is bent inwards towards the one of the opposite side. The arytæno-epiglottidean fold is connected with it. Two cartilages of Santorini.

Cuneiform cartilages.—Two other very small fibro-cartilaginous bodies, one on each side, which are contained in the arytæno-epiglottidean folds, have received this name. They are somewhat circular or conical in form, and are situate near the capitula of the arytænoid cartilages: the situation of each in the fold of the mucous membrane is marked by a slight projection. Two cuneiform cartilages.

The *epiglottis* is a piece of fibro-cartilage that in form resembles a leaf, with the stalk below, and the lamina or expanded part above. Its position is behind the tongue, and in front of the upper orifice of the larynx. Epiglottis. Form and position.

The anterior surface is bent forwards to the tongue, to which it is connected by three folds of mucous membrane. The posterior surface is hollowed from side to side, but convex from above down. To its sides are united the arytæno-epiglottidean folds of mucous membrane. The lower part is connected by a fibrous band (thyro-epiglottidean ligament) to the posterior aspect of the thyroid cartilage, near the notch in the upper border. The epiglottis is further connected to the hyoid bone and the root of the Surfaces. Sides. Footstalk.

Glands in it.

tongue by strong bands of tissue. After the mucous membrane is removed from the epiglottis, the fibro-cartilaginous structure is seen to be perforated by numerous apertures that lodge muciparous glands.

Supposed gland.

Between the epiglottis and the hyoid bone is a mass of yellowish fat, which has been incorrectly named by some the epiglottidean gland.

Ligaments of the larynx,

LIGAMENTS OF THE LARYNX. — The larynx is connected by ligaments with the hyoid bone above and the trachea below. Moreover, there are connecting fibres uniting together the cartilages, and between some of the cartilages synovial membranes exist.

between os hyoides and trachea.

Union of the larynx with the hyoid bone and the trachea. — A thin loose membrane (thyro-hyoid) passes from the thyroid cartilage to the hyoid bone, and a second membrane connects the cricoid cartilage with the trachea.

Thyrohyoid membrane.

a. The *thyro-hyoid ligament* is attached on the one part to the upper border of the thyroid cartilage, and on the other to the upper border of the hyoid bone, at the posterior aspect. Of some thickness in the centre, it gradually becomes thinner towards the sides, and finally ends in a rounded cord, between the extremity of the hyoid bone and the upper cornu of the thyroid cartilage. The superior laryngeal nerve and artery perforate this ligament, and a synovial membrane is placed between it and the posterior surface of the hyoid bone.

Crico-tracheal membrane.

b. The membrane joining the lower border of the cricoid cartilage to the first ring of the trachea (*crico-tracheal ligament*), resembles the bands that join one ring of the trachea to another.

Between cricoid and thyroid cartilages are

Union of the cricoid and thyroid cartilages. — These cartilages are joined in the middle line in front by the crico-thyroid ligament, and on the side by a capsular ligament around the small cornu of the thyroid cartilage.

an anterior ligament

a. The *anterior crico-thyroid ligament* or membrane is thick and strong in the centre, and is attached to the contiguous margins of the carlages from which it is named. But on the sides the ligament is thin, and leaving the lower border of the thyroid cartilage is continued upwards to the chorda vocalis. Some small apertures exist in this membrane for the passage of small arteries into the larynx. The ligament is partly concealed by the crico-thyroid muscle.

and a lateral joint.

b. The *lateral crico-thyroid* or *capsular ligament* surrounds the articular surfaces between the side of the cricoid, and the lower cornu of the thyroid cartilage. Its fibres are strongest behind. A *synovial membrane* lines the capsule.

Articulation between the cricoid and arytænoid cartilages.— This articulation allows of most movement, and the surfaces of the cartilages which are in contact are retained by a capsule, and possess a synovial sac. Between cricoid and arytænoid

The *capsular ligament* is fixed to each cartilage around its articular surface, and one part (posterior ligament) is strongest on the inner and posterior aspects. A loose *synovial membrane* is present in the articulation. is a capsule and sac.

A kind of *capsule* with a *synovial sac* unites the apex of the arytænoid cartilage with the hollowed base of the cartilage (capitulum) of Santorini. Sometimes these cartilages are blended together. Between arytænoid and capitulum.

The *ligaments* uniting the *thyroid and arytænoid cartilages* (thyro-arytænoid) have been already seen in the interior of the larynx (p. 147). Between thyroid and arytænoid.

Ligaments of the epiglottis.—A band (*thyro-epiglottidean*) connects the lower part of the epiglottis to the posterior surface of the thyroid cartilage, close to the excavation in the upper border. Some fibrous and elastic tissue (*hyo-epiglottidean ligament*) likewise connects the front of the epiglottis to the hyoid bone. Two ligaments of epiglottis.

STRUCTURE OF THE TRACHEA. — The anterior part of the trachea will be seen to be formed of a series of pieces of cartilage (segments of rings), which are connected together by fibrous tissue. The interval at the back of the tube, between the cartilages, is closed by fibrous membrane, by muscular fibres, and muciparous glands. And the tube is lined by the mucous membrane, and a subjacent elastic tissue. Constituents of trachea.

Cartilages.—The pieces of cartilage vary in number from sixteen to twenty. Each forms an incomplete ring, which occupies about three fourths of a circle, and each is convex forwards, forming the front and sides of the tube. At the extremities of the trachea these cartilaginous pieces are least constant in size and form; for towards the larynx they increase in depth, and the lowest cartilage is shaped like the letter V. At the extremes also the cartilages may be slit at their ends, or may be blended together. The cartilages are united by a fibrous tissue that is continued from one to another on both aspects, though in greatest quantity externally, and is extended across the posterior part of the air tube. Cartilages. Form. Peculiarities are contained in fibrous tissue.

Dissection.—Remove the fibrous membrane and the muciparous glands from between the cartilages at the back of the trachea, and the muscular Dissection.

fibres will be exposed. After the muscular fibres are examined, they may be cut through to see the elastic tissue and the mucous membrane.

Muscular fibres close trachea behind. *Muscular fibres.* — Between the ends of the cartilages is a continuous layer of transverse unstriped fibres, which are attached on the sides to the truncated ends of the cartilages. By the one surface the fibres are in contact with the fibrous membrane and the glands, and by the other with the next structure.

Elastic tissue lines trachea. The *elastic tissue* forms a complete lining to the tracheal tube, though at the posterior part, where the cartilages are deficient, it is gathered into strong longitudinal folds. This layer is closely connected with the mucous membrane.

Mucous membrane, epithelium, and glands. The *mucous membrane* of the trachea lines the tube, and resembles that of the larynx, with which it is continuous, in being furnished with a columnar ciliated epithelium. Connected with this membrane are numerous muciparous compound *glands* of variable size. The largest set are found at the back of the trachea, in the interval between the cartilages, where they are placed superficially to and beneath the fibrous membrane of that part: their ducts pass forwards between the muscular fibres to the surface of the mucous membrane. Other smaller glands occupy the front and sides of the trachea, being situated on and in the fibrous tissue connecting the cartilaginous rings.

Section XVIII.

PREVERTEBRAL MUSCLES AND VERTEBRAL VESSELS.

Deep muscles of spine. On the part of the spinal column that was laid aside after the separation of the pharynx from it, the student should examine the deep muscles on the front of the vertebræ.

Dissection. *Dissection.* — To expose these muscles, it is necessary to remove the cellular membrane. The muscles are three in number on each side, and are easily distinguished: the largest one, nearest the middle line, is the longus colli; the muscle external to this, which reaches to the head, is the rectus capitis anticus major; and the small muscle, external to the last and close to the skull, the rectus capitis anticus minor. The small rectus muscle is usually injured in cutting through the basilar process of the occipital bone.

Longus colli. The LONGUS COLLI MUSCLE is situate on the side of the bodies of the cervical and upper dorsal vertebræ, and is tendinous and pointed above, but larger below. It consists of

Origin

two parts — internal and external. The internal part *arises* by fleshy and tendinous processes from the bodies of the two upper dorsal and two lower cervical vertebræ, and from the intervening fibro-cartilages. This part of the muscle ascends, and being joined by the external piece, which takes origin from the transverse processes of four cervical vertebræ (sixth, fifth, fourth, and third), is *inserted* into the bodies of the four upper cervical vertebræ. In contact with the anterior surface of this muscle is the pharynx. The inner border is at some distance inferiorly from the muscle of the opposite side, but superiorly only the pointed anterior common ligament of the spine separates the two. The outer border is contiguous to the scalenus, to the vertebral vessels, and to the rectus capitis anticus major muscle.

by two pieces. Inser-tion. Parts in contact with it.

The RECTUS CAPITIS ANTICUS MAJOR is external to the preceding muscle, and is largest at its upper end. Its *origin* is by pointed tendinous slips from the anterior tubercles of the transverse processes of four cervical vertebræ (sixth, fifth, fourth, and third), and the fibres ascend to be *inserted* into the basilar process of the occipital bone, in front of the foramen magnum. The anterior aspect of the muscle is covered by the pharynx, and by the internal carotid artery and the numerous nerves near the base of the skull. This muscle partly conceals the following one.

Rectus capitis major. Origin. Inser-tion. Connec-tions.

The RECTUS CAPITIS ANTICUS MINOR is a small flat muscle, that *arises* from the transverse process, and partly from the anterior arch of the atlas, and ascends to be *inserted* into the basilar process of the occipital bone, between the foramen magnum and the preceding muscle. The anterior division of the suboccipital nerve lies between the borders of this muscle and the rectus capitis lateralis.

Rectus capitis minor is be-neath preced-ing.

Dissection.—The small intertransversales will come into view when the other muscles are removed from the front and back of the transverse processes. By tracing towards the spine the anterior division of one of the cervical nerves, the muscles will be readily found, for they are placed on the sides of the nerve. After the muscles and nerves have been examined, cut off the tips of the transverse processes to lay bare the vertebral artery.

Dissec-tion.

The INTERTRANSVERSE MUSCLES are slender fleshy slips Inter-

trans-verse muscles. Number and attachments. that occupy the intervals between the transverse processes. In the neck there are seven pair — one for each space; and the first pair is between the atlas and the axis, whilst the last is between the last cervical and the first dorsal vertebra. One set is attached to the anterior, and the other to the posterior tubercles of the transverse processes. Between the muscles, except in the first two spaces, is the anterior division of a cervical nerve, and beneath the posterior muscle

Peculiarities. is the other division of the same nerve. In the upper intertransverse space the posterior muscle is often wanting; and, in the lowest space, the muscle of the anterior set is smaller than the others, or it may be absent.

Cervical nerves in their foramina give *Exit of the cervical nerves from the spinal canal.* — The cervical nerves issue from the spinal canal through the intervertebral foramina with two exceptions, and bifurcate into an anterior and a posterior trunk.

anterior *a.* The *anterior division* passes outwards between the intertransverse muscles, and joins the plexuses in the neck.

and posterior division. *b.* The *posterior division* turns to the back beneath the posterior intertransverse muscle, and the other muscles attached to the posterior tubercles of the transverse processes, lying between the articular processes of the vertebra.

First two nerves differ The *first two nerves* leave the spinal canal above the posterior arches of the first two vertebræ, and then divide into anterior and posterior trunks.

in both anterior and *a. Anterior division.* — The anterior part of the first or suboccipital nerve has been examined (p. 108.); and the anterior division of the second nerve, after perforating the membrane between the posterior arches of the second and third vertebræ, is directed forwards, outside the vertebral artery, and beneath the intertransverse muscle of the first space, to join the cervical plexus.

posterior divisions. *b.* The *posterior divisions* of the first two nerves are described in the dissection of the back.

Vertebral artery in the foramina of cervical vertebræ. The *vertebral artery* has been seen at its origin in the neck (p. 65.), and its termination is described with the vessels of the brain. Entering the foramen in the transverse process of the sixth cervical vertebra (usually), the artery ascends vertically through the foramina in the transverse processes; and having passed through the aperture in the atlas, the vessel turns backwards on the posterior arch of that bone, and enters the skull

through the foramen magnum, after piercing the ligament joining the atlas and occipital bone. In its course through the foramina, the artery lies in front of the anterior trunks of the cervical nerves, except those of the first and second, the former of which crosses on the inner, and the latter on the outer side of the vessel. The vessel is accompanied by a vein and a plexus of nerves of the same name. In its course the artery furnishes small twigs to the spinal canal and the contained cord.

Position to nerves.

A vein and nerves are with it.

The *vertebral vein* commences by small radicles in the occiput and the muscles of the back of the neck, and enters the aperture in the transverse process of the atlas, where it sometimes receives a vein through the posterior condyloid foramen of the occipital bone. Accompanying the artery, the vein traverses the apertures in the transverse processes, and ends in the subclavian vein. In its course it receives branches from the spinal veins, both internal and external; its other branches are described at p. 66.

Vertebral vein

ends in subclavian.

Branches.

The *vertebral plexus of nerves* is derived from the inferior cervical ganglion of the sympathetic. The plexus surrounds the artery, and communicates with the spinal nerves as high as the third or fourth.

Plexus of nerves.

Section XIX.

LIGAMENTS OF THE VERTEBRÆ AND OF THE CLAVICLE.

On the remaining part of the spine the ligaments that connect the cervical vertebræ one to another, and to the occipital bone, are to be examined.

Dissection.—Disarticulate the seventh cervical from the first dorsal vertebra, and remove altogether the muscles, vessels, nerves, and cellular structure from the vertebræ. Then saw through the occipital bone, so as to leave only an osseous ring bounding posteriorly the foramen magnum, and clean the ligaments between the atlas and the occipital bone.

Dissection.

The COMMON LIGAMENTS attaching together the cervical vertebræ are the same as belong to the vertebræ in other parts of the spine, viz. an anterior and a posterior strong ligament, ligamentous bands between the laminæ and spines of the bones, and capsular ligaments and synovial membranes between the articulating processes, together with

Common ligaments of a vertebra.

an inter-articular fibro-cartilage between the bodies of the vertebræ.

These ligaments described elsewhere.

These ligaments are first to be examined: their description is given with the ligaments of the spine, at the end of the dissection of the thorax. But in opening the spinal canal to see the ligaments inside it, the arches of the three highest vertebræ should be left untouched.

Special ligaments are found

SPECIAL LIGAMENTS unite the first two cervical vertebræ one to another and to the occipital bone: some of these are external to, and others within the spinal canal.

externally between first two vertebræ and occipital bone, viz.

The *ligaments outside the spinal canal* are thin fibrous membranes that connect the arches of the first two vertebræ in front and behind, and the arch of the atlas with the occipital bone at the same aspects. Capsular ligaments surround the articular surfaces of all these bones, which will be examined more conveniently after the spinal canal is opened.

posterior and anterior atlo-axoid;

a. Union of the atlas with the axis.— 1. The *posterior ligament* (atlo-axoid) is a thin loose membrane, which is attached by the one margin to the posterior arch of the atlas, and by the other to the arch of the axis. Below the superficial layer are some deeper and stronger fibres. 2. The *anterior ligament* unites the anterior parts of the first two vertebræ in the same manner as the preceding ligament connects their posterior arches. It is thickest in the middle.

and anterior and posterior occipito-atloid.

b. Union of the atlas with the occipital bone.— 1. The *anterior ligament* (occipito-atloid) passes from the anterior margin of the occipital bone, between the condyles, to the anterior arch of the atlas. The middle part of the ligament, which is fixed to the tubercle on the front of the atlas, is the thickest. 2. The *posterior ligament* is fixed to the posterior half of the foramen magnum (between the condyles), and to the posterior arch of the atlas. It is thin, and is perforated on each side by the vertebral artery and the posterior division of the suboccipital nerve.

Ligaments internally between same bones as below.

The *ligaments inside the spinal canal* are peculiar in form, and assist to retain the skull in position during the rotatory and nodding movements of the head. Between the occipital bone and the second vertebra are three strong ligaments — a central one, and two lateral or check ligaments;

and, moreover, the odontoid process of the axis is fixed against the posterior aspect of the anterior arch of the atlas by a strong transverse ligament.

Dissection. — Supposing the laminæ of the cervical vertebræ to be removed, except those of the first two bones, the posterior arches of these two vertebræ are to be sawn through internal to their articular processes. Afterwards the ring of the occipital bone that bounds posteriorly the foramen magnum is to be taken away. Lastly, the student should detach the tube of dura mater from the interior of the spinal canal; and on removing the upper part of the posterior common ligament of the bodies of the vertebræ, the central ligamentous band between the occipital bone and the axis (occipito-axoid) will come into view. Dissection.

a. Union of the occipital bone with the axis. — 1. The *central ligament* (occipito-axoidean) is a rather thick band, which is attached to the grooved or cranial aspect of the basilar process, and is connected with the posterior ligament of the bodies of the vertebræ. From this spot it descends over the odontoid process, and becoming narrower is inserted into the transverse ligament of the atlas, and into the body of the axis. Occasionally a bursa is found between the transverse ligament of the atlas and the superficial fibres of the occipito-axoidean ligament, which are continued to the second vertebra. Between skull and axis is a thick central band.

Dissection. — If the occipito-axoidean ligament is removed, the following lateral or check ligaments are seen, together with the transverse ligament. Dissection.

2. The *odontoid* or *check ligaments* are two strong bundles of fibres, one on each side: each is attached by one end to the apex and side of the odontoid process, and by the other to a depression on the inner surface of the condyle of the occipital bone. These ligaments are covered by the occipito-axoidean band, and diverge from a central point to the sides. Between them there is oftentimes a band of fibres, that connects the tip of the odontoid process to the basilar part of the occipital bone. And two lateral or check ligaments.

b. Union of the atlas with the axis. — The *transverse ligament* of the atlas is a flat strong band behind the odontoid process, which is attached on each side to a depression on the To fix odontoid process there is a

transverse ligament inner part of the articular process of the atlas. This ligament is thickest in the centre, where it projects above the odontoid process, and is joined by the deep fibres of the occipito-axoidean ligament. Its surface towards the cord is concealed by the occipito-axoid ligament. This ligament fixes firmly the odontoid process of the second vertebra against the anterior arch of the atlas, confining it in a ring. If the transverse and check ligaments are cut through, the tip of the odontoid process will be seen to have two cartilaginous surfaces; one in front where it touches the atlas, the other at the opposite aspect, where it is in contact with

and two synovial membranes. the transverse ligament. Two *synovial membranes* facilitate the movements of the odontoid process, one being between that piece of bone and the atlas, and the other between it and the transverse ligament.

Capsular ligaments and synovial membranes to the articular surfaces *Union of the articular surfaces.* — *a.* The articular surfaces of the occipital bone and atlas are surrounded by a capsular ligament of scattered fibres, which is strongest externally and in front. When the joint is opened, the condyle of the occipital bone will be seen to look somewhat outwards, whilst the surface of the atlas has an opposite direction. A loose *synovial membrane* is placed between the bones. *b.* The articular surfaces of the first two vertebræ are enclosed by a capsule, which is stronger in front than behind. On opening the joint, the surfaces of the bones in contact will be seen to be almost horizontal. On each side there is a separate loose *synovial membrane*.

Joint at sternal end of clavicle. STERNO-CLAVICULAR ARTICULATION. — The internal end of the clavicle is received on a fibro-cartilage, and is retained in position by the following ligaments; anterior and posterior, with one to the first rib, and another between the ends of the two clavicles.

Dissection. *Dissection.* — For the examination of the ligaments in the sterno-clavicular articulation, take the piece of the sternum that was laid aside for that purpose. Remove the cellular membrane from the several ligaments; and should these have become dry, they ought first to be moistened for a short time.

An anterior, The *anterior ligament* is attached by a narrow point to the head of the clavicle, and from that spot the fibres diverge

in front of the interarticular cartilage, to be inserted before the articular surface on the sternum.

The *posterior ligament* is less strongly marked than the preceding, but it has attachments behind the bones corresponding to those of the anterior in front of them, viz. to the head of the clavicle and to the sternum. Like the anterior ligament it adheres to the fibro-cartilage. posterior,

The *interclavicular ligament* extends above the sternum, from the clavicle of one side to the corresponding bone of the other side. The fibres do not cross in a straight line, but dip into the hollow between the clavicles, and are connected with the upper part of the sternum. interclavicular,

The *costo-clavicular ligament* is a short strong band of oblique fibres that intervenes between the first rib and the clavicle. Inferiorly it is fixed to the upper surface of the cartilage of the first rib, and superiorly to the under surface of the clavicle near its sternal end. The subclavius muscle is in front of the ligament. Sometimes the clavicle touches the rib, and is provided with an articular surface and a synovial membrane at that spot. and costo-clavicular ligament.

The *interarticular fibro-cartilage* will come into view by cutting the ligaments before described, and raising the clavicle. It is flat, and almost circular in form, but is thicker at the circumference than the centre. By its upper surface the cartilage is united to the head of the clavicle, which is imbedded in it; and by the opposite surface it is connected to the cartilage of the first rib. The ligaments in front and behind the articulation are united to the margins of the fibro-cartilage. Sometimes there is an aperture in the centre of this interarticular cartilage. Fibro-cartilage.

Two *synovial membranes* are present in the articulation, one being on each side of the fibro-cartilage. The sac between the sternum and the fibro-cartilage is looser than that between the clavicle and the cartilage. Two synovial membranes.

CHAPTER II.

DISSECTION OF THE BRAIN.

SECTION I.

MEMBRANES AND VESSELS.

Position of the brain.

DURING the examination of the membranes, the vessels, and the nerves, the brain is to be placed upside down, resting in the coil of a cloth, which supports it evenly.

Three meninges.

MEMBRANES OF THE BRAIN.—The coverings of the brain (meninges) are three in number, viz. dura mater, pia mater, and arachnoid membrane. The dura mater is a firm, fibrous investment that supports parts of the brain, and serves as an inner lining to the bones. The pia mater is the most internal, and is a vascular layer. And the arachnoid is a thin serous sac, which is situate between the other two.

Besides enveloping the brain, these membranes are prolonged on the cord into the spinal canal, and will be noticed in the dissection of that part. The description of the dura mater will be found at p. 8.

Dura mater.

Arachnoid membrane.

The ARACHNOID is a thin serous membrane, which lines the inner aspect of the dura mater, and is reflected over the pia mater and the brain. Around the vessels and nerves intervening between the skull and the brain, the membrane forms sheaths which extend a short distance into the several apertures, and then become continuous with the parietal or cranial portion. Like other serous membranes, it forms a sac which contains a lubricating fluid; and it consists of a parietal and a visceral part.

Parietal part.

The *parietal* part is inseparably united to the inner surface of the dura mater, giving to it a smooth and polished aspect, and is continued in the same manner over the pieces of that membrane that project between the different portions of the brain.

The *visceral* part covers the encephalon loosely, especially on the under surface, and beneath it there is a considerable interval (subarachnoid space). When it is traced over the brain, the following is the disposition of the serous membrane. On the upper or convex surface of the brain the membrane passes from one convolution to another, without dipping into the intervening hollows; but it lines the great median fissure as low as the extent of the falx. It is said to be continued posteriorly into the lateral ventricle. On the lower or under surface of the cerebral mass the arachnoid covers the anterior lobes, and sinks into the median fissure: but farther back there is a space between it and the brain. Still more posteriorly the serous membrane is closely connected to the pons and to the under surface of the cerebellum; but between the hemispheres of the little brain there is another space beneath it, similar to that at the under part of the cerebrum. Visceral part is not close to brain, hollow beneath, varies at spots;

The *subarachnoid space*, or the interval between the arachnoid membrane and the pia mater, is larger in one spot than another, and contains more or less fluid (cerebro-spinal). In the fissure between the hemispheres, both of the cerebrum and cerebellum, and at the middle of the under part of the former, the subserous space is largest. If the arachnoid covering is removed from the fissure between the hemispheres of the cerebellum, the student will perceive the aperture of the fourth ventricle, by which the cavity in the interior of the brain communicates with the subserous space both of the encephalon and of the spinal cord. it is the sub-arachnoid space.

The PIA MATER, or the vascular covering of the brain, closely invests the different parts of the cranial mass, and dips into the fissures, as well as into the hollows between the convolutions and the laminæ. Besides covering the exterior of the brain, it sends processes into the interior to supply vessels to the walls of the enclosed spaces: thus, one penetrates into the cerebrum below the corpus callosum, and is named velum interpositum; and two vascular fringes project into the fourth ventricle, and are known as the choroid plexuses of that ventricle. Pia mater sends pieces into the brain;

it is a net-work of blood-vessels.

This membrane is a net-work of vessels, and is constructed chiefly out of the minute ramifications of the arteries before they enter the substance of the brain; the intervals between the vessels being closed by cellular tissue, so as to form a continuous membrane. From the under surface of the pia mater proceed numerous fine vessels for the nutrition of the brain.

Dissection of the vessels.

Dissection.—To expose the arteries, let the brain remain upside down, and let the arachnoid membrane be taken from the vessels that are evident. Follow forwards the two arteries that lie in the median fissure of the great brain; next the artery that passes outwards transversely across the brain; and, lastly, a vessel that bends backwards along the inner part of the half of the great brain (cerebrum). One artery is seen ramifying on the upper surface (in the present position) of the cerebellum, and another is to be followed to the under surface.

Before entering into the detail of the anatomy of the arteries, it may be advisable to mention shortly the different divisions of the brain, and the larger parts that are seen on its under-surface.

Outline of cranial mass.

The *cranial* or *encephalic* mass of the nervous system consists of cerebrum or great brain, cerebellum or small brain, and pons and medulla oblongata. Each of these parts has the following situation and subdivisions:—

Upper part of spinal cord.

The medulla oblongata, or the upper end of the spinal cord, lies in the groove between the halves of the small brain, and is divided into two symmetrical parts by a median fissure. To its sides and upper part some of the cranial nerves are united.

Pons Varolii

The pons Varolii is situate in front of the medulla oblongata, and is marked along the middle by a groove, which indicates its separation into two halves. In front of it are two large processes that pass to the great brain (crura cerebri); on each side it is united to the small brain by a similar white mass (crus cerebelli); and behind is the enlarged upper part of the cord.

and its crura.

Cerebellum.

The cerebellum, or the small brain, is divided into two halves by a median fissure, and each half will be subsequently seen to be subdivided into lobes.

The cerebrum, or the large brain, is also divided into two halves, by a longitudinal fissure in the middle line. Each half is further subdivided into anterior, middle, and posterior lobes. Between the anterior and the middle lobe is the fissure of Sylvius, but the limit between the middle and the posterior is only a line corresponding to the anterior part of the small brain. In the middle line of the cerebrum, between the hemispheres and in front of the pons, are several small bodies that will be afterwards enumerated. Cerebrum and its great divisions.

ARTERIES OF THE BRAIN. — The brain is supplied with blood by the two vertebral and the two internal carotid arteries. Arteries of the brain.

The *vertebral artery* is a branch of the subclavian artery, and enters the spinal canal by piercing the membrane between the atlas and the occipital bone. Then ascending to the brain, round the side of the medulla oblongata, the artery enters the skull through the foramen magnum, and is blended with its fellow in one trunk (basilar) at the lower border of the pons. As the vessel winds round the upper part of the cord, it lies between the roots of the ninth and suboccipital nerves; but it is afterwards internal to the ninth. Vertebral ends in basilar, winds round medulla.

Branches.—Between its entrance into the spinal canal and its termination, each artery furnishes offsets to the spinal cord, to the dura mater, and to the cerebellum. Branches

1. The *posterior spinal branch* is of inconsiderable size, and arises opposite the posterior part of the cord: it descends along the side of the cord, behind the nerves, anastomosing with its fellow, and with branches that enter by the intervertebral foramina. of spinal cord, anterior and

2. The *anterior spinal branch* is as small as the preceding, and is an offset opposite the front of the spinal cord. This small branch joins the corresponding twig of the opposite side, and the resulting vessel is continued along the middle of the cord on its anterior aspect. posterior.

3. The *posterior meningeal artery* leaves the vertebral trunk opposite the foramen magnum, and ramifies in the dura mater lining the fossæ of the occipital bone. of dura mater.

4. The *inferior cerebellar artery* (posterior) is distributed to the under surface of the cerebellum. Taking origin from the end of the vertebral or from the basilar artery, this branch winds backwards round the side of the medulla, between the pneumo-gastric Branch of the under part of cerebellum.

and spinal accessory nerves, to enter the median fissure of the cerebellum. Directed onwards along the fissure, the artery reaches the upper surface of the cerebellum, and there anastomoses with the superior cerebellar artery. A branch of the artery ramifies over the under surface of the cerebellum, and ends externally by anastomosing with the upper cerebellar artery. As the vessel lies by the side of the aperture of the fourth ventricle, it gives a small offset to the choroid plexus of that cavity.

Basilar artery. Extent and situation. The *basilar artery* is the vessel resulting from the union of the two vertebral arteries. It reaches from the lower to the upper border of the pons, and ends at the last spot by dividing into two branches (posterior cerebral) for the cerebrum. The vessel touches the basilar process of the occipital bone (thence receiving its name), and corresponds to the median groove of the pons. On each side of and almost parallel to it is the sixth nerve.

Branches: *Branches.* — Besides the terminal branches mentioned above, the artery supplies transverse arteries to the pons and to the under part of the cerebellum, and a large branch to the upper surface of the cerebellum.

Transverse to the pons 1. The *transverse arteries* of the pons are four or six small twigs, that are named from their direction, and are distributed to the substance of the pons. One of these gives an offset to the internal auditory meatus along the seventh nerve. Resembling most this set of branches is the following artery, the *inferior cerebellar* (anterior): this arises from the basilar trunk, and is directed outwards to the under-surface of the cerebellum at the anterior part, on which it is distributed. and inferior cerebellar.

Superior cerebellar. 2. The *superior cerebellar artery* is derived from the basilar so near its termination, that it is often described as one of the final branches of that vessel. Its destination is the upper aspect of the cerebellum, to which it is directed backwards over the third nerve and the crus cerebri, but parallel to the fourth nerve. On the upper surface of the cerebellum the artery spreads out in branches, and its ramifications anastomose with the vessel of the opposite side, and with the inferior cerebellar artery. Some twigs of this vessel enter the piece of the pia mater that projects into the posterior part of the cerebrum, viz. the velum interpositum.

Posterior cerebral artery, 3. The *posterior cerebral artery* takes on each side a backward course, similar at first to the preceding artery, but separated from it by the third nerve. The vessel is then inclined to the posterior lobe of the cerebrum at its inner part, and divides into many branches. Some of these supply the under part of the posterior

lobe, whilst others turn upwards both on the outer and inner aspects of the back of the hemisphere, and anastomose with the other cerebral arteries.

Numerous small long branches leave the posterior cerebral artery close to its origin, and enter the base of the brain between the crura cerebri (posterior perforated spot). Soon afterwards the vessel is joined by a small straight branch (posterior communicating) from the internal carotid artery. Lastly, it furnishes a small *choroid* artery to the fold of pia mater that projects into the cerebrum: this small branch winds round the crus cerebri, and is transmitted between the crus and the hemisphere of the cerebrum to the velum interpositum and the choroid plexus.

its offsets are commu-nicating and cho-roid.

From the foregoing examination of the branches of the vertebral arteries and of the trunk (basilar) that continues them onwards, it appears that about half the encephalon — viz. the medulla oblongata, the pons, the cerebellum, and the posterior third of the cerebrum — receives its blood through those branches of the subclavian arteries.

Part of brain supplied by ver-tebral arteries.

The INTERNAL CAROTID ARTERY terminates in the brain by supplying branches to its remaining two thirds, or to the anterior and middle lobes. Having passed through the space of the cavernous sinus (p. 19.), the vessel emerges on the inner side of the anterior clinoid process, and divides at the inner end of the fissure of Sylvius into anterior cerebral, middle cerebral, and posterior communicating arteries. At the base of the brain the carotid artery lies between the second and third nerves, but nearest the former.

Internal carotid ends in cerebral arteries.

Branches. — In the skull the carotid artery supplies the ophthalmic artery, before it ends in the following terminal branches of the cerebrum.

Branch-es.

1. The *anterior cerebral artery* supplies the inner part of the cerebral hemisphere. The vessel of each side is directed forwards to the median fissure between the hemispheres; and as the two are about to enter it, they are united by a short thick artery, the *anterior communicating*. Each artery then runs forwards in the fissure, and bends round the anterior part of the corpus collosum, so as to be placed on its upper aspect in the natural state of the brain. Still continuing backwards nearly to the posterior extremity of the hemisphere, the artery gives off numerous branches, which anastomose with the other cerebral arteries.

Anterior cerebral supplies inner part of hemi-sphere; commu-nicating artery

its offsets. Near its commencement this artery furnishes many small branches to the part of the brain contiguous to the inner end of the fissure of Sylvius (anterior perforated space); and it distributes also some branches to the under part of the anterior lobe.

Middle cerebral artery 2. The *middle cerebral artery* is the largest offset of the internal carotid, and supplies the outer part of the hemisphere. Passing outwards in the fissure of Sylvius, the artery divides in it into many

ends in outer part of hemisphere. large branches, that issue at the outer end, and spread over the external aspect of the hemisphere of the cerebrum, inosculating with the other two cerebral arteries at the front, the back, and the upper part of the brain.

Offsets. At the inner end of the fissure of Sylvius numerous small branches arise from the middle cerebral artery, and enter the cerebral substance through the part called locus perforatus anticus.

Posterior communicating. 3. The *posterior communicating artery* is a small twig that is directed backwards parallel to the third nerve, and on its inner side, to join the posterior cerebral artery near the pons.

Choroid artery. 4. The *choroid artery* (anterior) is small in size, and arises either from the trunk of the carotid, or from the middle cerebral artery. It passes backwards on the outer side of the preceding, and finds its way between the hemisphere and the crus cerebri to the choroid plexus of the lateral ventricle.

Circle of Willis; *Circle of Willis.*—This term has been applied to the chain of communications between the arteries at the base of the brain; for the vessels of the brain are united freely both on their own side and across the middle line, giving rise to an arterial circle. On

vessels that take a share in it, each side this circle is formed by the trunk of the internal carotid, giving forwards the anterior cerebral, and backwards the posterior communicating artery. In front it is constructed by the converging anterior cerebral and the anterior communicating artery; and behind, by the bifurcation of the basilar artery into the posterior cerebral arteries. In the area of the circle lie the several parts of the brain that correspond to the floor of the third ven-

and the free inosculation between them. tricle. The complete inosculation between the cranial vessels in the circle of Willis allows at all times a free circulation of blood through the brain, even though a large vessel on one side should be obstructed.

Veins of the brain. The VEINS of the brain enter the sinuses of the dura mater instead of uniting into trunks that are companions to the arteries.

Dissection. *Dissection.*—The pia mater and the vessels are now to be removed from the brain, and the origin of the cranial nerves to be

defined. Over the greater part of the cerebrum, the pons, and the medulla, the pia mater is detached with tolerable facility by using two pair of forceps; but over the cerebellum the membrane adheres so closely that it will require some care to remove it without tearing off the cortical layer of that part. In clearing out the fissure between the halves of the cerebellum on the under surface, the membrane that bounds on each side the opening of the fourth ventricle will probably be taken away. The student should therefore observe the position and size of that opening between the back of the medulla oblongata and the inferior vermiform process. When the surface is clean, the brain is to be replaced in the spirit till it is hardened.

Care to be taken in removing pia mater.

SECTION II.

ORIGIN OF THE CRANIAL NERVES.

THE cranial nerves take origin from the encephalon, with one exception (spinal accessory), and leave the skull through apertures therein.

Origin

The place at which a nerve appears on the surface of the brain does not determine its origin; for fibres or roots may be traced deeply from the surface into the nervous substance. Each nerve has, therefore, an apparent and a real origin in the encephalon.

is apparent and real.

The cranial nerves may be regarded either as nine or twelve pairs, according to the mode of classifying them. Those writers who take the smaller number include in one nerve all the trunks contained in the same aperture of the skull: for instance, the eighth nerve, which consists of three trunks in the foramen lacerum jugulare. But those who enumerate twelve nerves consider each distinct trunk issuing from the encephalon to constitute a separate cranial nerve, whether it may be alone, or combined with others in its foramen of exit. The designation of the several nerves may be numerical; or their names may further be derived from the parts to which they are distributed, or from the function of the part supplied by them.

Classification and designation.

The FIRST OR OLFACTORY NERVE is very soft and pulpy, being destitute of a neurilemma, and has both grey substance and white fibres in its composition, like the cerebrum. It is

Olfactory nerve

a flat-looking band, wider at each end than in the middle, which is lodged in a sulcus on the under aspect of the anterior lobe of the cerebrum, and is kept in position by the reflection of the arachnoid membrane over it. When the nerve is raised from its sulcus it is prismatic in form, the apex of the prism being directed downwards in this position. Anteriorly, the nerve swells into the olfactory bulb, a greyish looking mass, that distributes nerves to the nose; and posteriorly it is connected to the cerebrum by three roots of origin, external, internal, and middle.

lies on anterior lobe, forms olfactory bulb,

has external

The *external* or *long root* is a slender white band, which passes along the outer part of the anterior perforated space, and across the fissure of Sylvius, and disappears by sinking into the substance of the middle lobe of the cerebrum.

internal and

The *internal* or *short root* is also white, and consists of small fibres that come from the inner part of the anterior lobe of the cerebrum.

middle root.

The *middle* or *grey root* is connected with a conical elevation at the posterior part of the sulcus which lodges the nerve.

Deep origin.

Deep origin.—The external root is said to be connected with the anterior commissure and the convolutions of the island of Reil; the inner root joins the front of the corpus callosum, or the white fibres of a convolution to be afterwards examined (gyrus fornicatus); and the middle root encloses white fibres, which are found to reach the corpus striatum.

Optic nerve, part called tract,

The SECOND or OPTIC NERVE is the largest of the cranial nerves, except the fifth, and appears as a flat band on the crus cerebri; anteriorly the nerves of opposite sides are united in a commissure. The part of the nerve posterior to the commissure is named *optic tract*, and is connected to the crus cerebri; but the part beyond the commissural union is round and firm, being invested by a neurilemma, and is called optic nerve. The destination of the nerve is to the eye.

part. nerve.

Origin from cerebrum.

The nerve takes origin from two of the corpora quadrigemina (nates and testis of one side), and from the optic thalamus and the corpora geniculata; but this attachment will be afterwards seen. As the nerve reaches forwards to the commissure, it is attached to the crus cerebri by its outer

or anterior edge; and when it is placed in front of the tuber cinereum, it receives other filaments from that body.

The *commissure* (chiasma) of the optic nerves is somewhat of a square shape, and lies on the olivary eminence of the sphenoid bone, within the circle of Willis. It is placed in front of the tuber cinereum; and passing beneath it, in this position of the brain, is the thin lamina cinerea. In the commissure there is a partial crossing of the fibres of the nerves of opposite sides after this manner; the outer fibres of each nerve are continued straight to the eyeball of the same side, but the inner fibres decussate, those of the right nerve being continued to the left, and *vice versâ*. Some transverse fibres have been described at the front and back of the commissure. Its commissure. Situation and structure

The THIRD NERVE, muscular nerve of the eyeball, is round and firm, and is attached to the inner aspect of the cerebral peduncle, near the locus perforatus, and close in front of the pons Varolii. Origin of third nerve is

Deep origin. — The fibres of the nerve separate as they pierce the peduncle, and enter the locus niger, as well as the bundles of longitudinal fibres on each aspect of that body. Some of the roots are said to be traced to the pons Varolii, to the nates, and to the fibres of the superior peduncle of the cerebellum. deep in crus cerebri.

The FOURTH OR TROCHLEAR NERVE cannot be followed backwards, at present, to its origin. It is the smallest of the cranial nerves, and arises from the valve of Vieussens, over the fourth ventricle. The nerve appears between the cerebrum and the cerebellum, on the side of the crus cerebri, and is then directed forwards to enter an aperture in the tentorium cerebelli, near the posterior clinoid process. Origin of fourth nerve from cerebellum.

The FIFTH OR TRIFACIAL NERVE is the largest cranial nerve, and consists of two roots, large and small. This nerve resembles a spinal nerve, in possessing ganglionic and aganglionic roots, the former giving sensory, and the latter motor power, which are blended beyond the ganglion. Fifth nerve has two roots.

The nerve is attached to the side of the pons Varolii, nearer the upper than the lower border. The small root is highest, and is separated from the other by two or three of the transverse fibres of the pons. Both roots pass out- Origin from pons.

wards through an aperture in the dura mater, above the petrous part of the temporal bone.

Deep origin uncertain.

Deep origin.—The *small root* is supposed to be connected with the fibres of the pyramidal body. The *large root* may be traced through the transverse fibres of the pons to the floor of the fourth ventricle, where it is said to be connected with the fasciculus teres, or the prolongation of the lateral column of the spinal cord. Some anatomists trace it to the lateral column in the medulla oblongata, behind the olivary body.

Origin of sixth nerve.

The SIXTH NERVE, abducent nerve of the eyeball, arises from the pyramidal body, close to the pons, and sometimes from the lower part of the pons.

Seventh nerve has two parts.

The SEVENTH CRANIAL NERVE (Willis) appears at the lower border of the pons, where this is joined by the restiform body. It consists of two distinct trunks, facial and auditory.

Origin of the facial.

a. The *facial nerve* (portio dura, seventh nerve, Soemmerring) is firm and round, and smaller than the auditory, internal to which it is placed. It springs from the anterior part of the restiform body, close to the pons, and from the lower border of the pons.

Small accessory piece.

The facial nerve is united with a small accessory band of fibres intermediate between it and the auditory (Wrisberg); it is then applied to the auditory nerve, and the two enter the internal meatus.

Auditory part.

b. The auditory nerve (portio mollis, eighth nerve, Soemmerring) arises in the floor of the fourth ventricle, and in the restiform body.

Deep origin.

Deep origin.—The *facial nerve* is connected with the restiform body, and with an offset from the pyramidal and the olivary body (olivary fasciculus). The *auditory nerve* arises from the restiform body, as well as from the grey matter of the fourth ventricle, some roots coming out of the median groove in that part; whilst the intermediate part of Wrisberg passes deeply to the fibres of the lateral column of the cord.

Eighth nerve has three parts.

The EIGHTH CRANIAL NERVE (Willis) is placed along the side of the medulla oblongata, being attached to the restiform body, and consists of three distinct trunks, glosso-pharyngeal, pneumo-gastric, and spinal accessory.

Origin of glosso-pharyngeal,

a. The *glosso-pharyngeal nerve* (ninth nerve, Soemmerring) is the smallest of the three, and is situate highest. Its

apparent origin is by three or more fibrils from the inner part of the restiform body, close to the facial nerve.

b. The *pneumo-gastric* or *vagus* (tenth nerve, Soemmerring) is attached to the restiform body, below the glosso-pharyngeal nerve, by a series of filaments that are collected into bundles, and are then united in one large flat band. vagus,

c. The *spinal accessory nerve* (eleventh nerve, Soemmerring) is firm and round, like the third or the sixth nerve. It takes origin, by a number of fine filaments, from the lateral surface of the cord, as low as the sixth cervical vertebra. The nerve ascends along the cord between the ligamentum dentatum and the posterior roots of the spinal nerves, with the upper of which it is sometimes connected. It then enters the skull by the foramen magnum, and receives filaments from the lower part of the restiform body, in a line with the roots of the pneumo-gastric nerve. and spinal accessory part,

All three of the nerves converge to a spot below the crus cerebelli, where they rest on a small lobe of the cerebellum (flocculus), and are then directed outwards to the foramen lacerum jugulare (p. 18.). all converge in the skull.

Deep origin.—According to Stilling each of these nerves takes origin from a special mass of grey matter (its nucleus) at the back of the medulla oblongata. That of the glosso-pharyngeal is highest, and the one of the pneumo-gastric next below; both these form projections in the floor of the fourth ventricle, near the lower part of the calamus scriptorius. The nucleus of the spinal accessory nerve is contained in the medulla, lower down than the preceding. The deep origin uncertain.

The NINTH OR HYPO-GLOSSAL NERVE of Willis (twelfth nerve, Soemmerring) is placed on the front of the medulla oblongata, and arises by a series of filaments from the sulcus between the pyramidal and olivary bodies, in a line with the anterior roots of the spinal nerves. Ninth nerve.

The filaments of origin unite into two bundles, which separately pierce the dura mater, and do not become blended together till they are outside the cranial aperture. Origin from medulla.

Deep origin. — Stilling traces the filaments of this nerve to a nucleus in the floor of the fourth ventricle, which projects close to the calamus scriptorius, and is internal to those of the glosso-pharyngeal and vagus nerves. Deep origin.

SECTION III.

MEDULLA OBLONGATA AND PONS VAROLII.

THE medulla oblongata and the pons are interposed between the spinal cord and the brain, and in them the elements of the cord are re-arranged and increased before entering the cerebrum and the cerebellum.

Position of the part and directions. *Position.*—The brain is to remain in the position in which it was placed during the examination of the nerves and the vessels. On a single brain the student may ascertain nearly all the anatomy of the parts composing the medulla and the pons; but if he can procure a hardened specimen of the medulla and the pons united, and another of a vertical section through these same bodies, his knowledge will be much more perfect.

Upper part of spinal cord. Situation and form. The MEDULLA OBLONGATA is the upper dilated part of the spinal cord which is contained in the cranium. Its limit is the lower border of the pons in one direction, and the level of the upper margin of the atlas in the opposite direction. This part of the cord is pyramidal in form, and measures about one inch and a quarter in length, half an inch in thickness, and three quarters of an inch in breadth at its widest part.

Base. Apex. Surfaces. The larger part or the base of the medulla joins the pons, the transverse fibres of the latter marking its limit; and the apex is blended with the cord at the spot before mentioned. The anterior surface is irregularly convex, and is in contact with the hollowed basilar process of the occipital bone. The opposite surface is somewhat excavated superiorly, where it forms the floor of the fourth ventricle, and rests in the fissure between the halves of the cerebellum. On the posterior aspect there are not any cross fibres of the pons, as in front, to indicate the extent of the medulla.

Division into halves by fissures. The medulla oblongata is divided into halves by a median fissure in front and behind. The fissures are continuous with those along the cord, but their extent here is influenced by the difference before alluded to on the surfaces; for whilst the anterior one ceases at the pons in a dilated part

(foramen cæcum), the posterior is prolonged behind the pons, and forms the groove in the floor of the fourth ventricle. Each half of the medulla is marked by the following projections, which are situate from before backwards in the order now mentioned, viz. the anterior pyramid, the olivary body, the restiform body, and, lastly, the posterior pyramid. Components of each half

The *anterior pyramid* is the most internal eminence, and receives its name from its form and position. Situate on the side of the median fissure, it is internal to the olivary body, from which it is separated by a slight groove. Inferiorly, the pyramid is continuous with the anterior column of the cord, and internally it is connected with some decussating fibres across the anterior median fissure (decussation of the pyramids). Enlarging as it ascends, this body enters the pons, but, before disappearing beneath the transverse fibres, it is somewhat constricted and rounded. Anterior pyramid is most internal, and is joined internally by fibres.

The *olivary body* (corpus olivare) is the oval projection between the anterior pyramid and the restiform body. A groove separates it from both of those prominences, but the one next the restiform body is the widest. This body is shorter than the pyramid, and does not reach to the pons: its upper end is most prominent, and arching round the lower end, or sometimes over the surface, are some white fibres (arciform fibres). Olivary body does not reach pons. Some arched fibres.

The *restiform body* (restis, a rope) forms the largest prominence on the half of the medulla oblongata, and cannot be seen satisfactorily except on a distinct piece. Cord-like in form, this body is posterior to the corpus olivare, and projects laterally, so as to give the width to the upper part of the medulla oblongata. The restiform swelling is continuous inferiorly with the posterior column of the spinal cord, and superiorly it turns outwards to the cerebellum, of which it constitutes the inferior peduncle. Between the restiform bodies, at the back of the medulla, is the space of the fourth ventricle. Restiform body is the largest piece, diverges to cerebellum.

The *posterior pyramid* is a small slip behind the restiform body, and is a prolongation of that part of the spinal cord which is close to the posterior median fissure. By drawing forwards the medulla, or using a separate piece of hardened Posterior pyramid is close to posterior median fissure.

medulla, the pyramid will be seen to be slightly enlarged at the apex of the fourth ventricle, where the restiform bodies diverge, and then to ascend along the corpus restiforme, gradually becoming indistinct on the surface.

Fibres of the medulla. STRUCTURE. — The elements of the spinal cord, viz. anterior, middle, and posterior columns, are continued into the lower part of the medulla oblongata, where they can at first be recognised. But they soon become mixed together, and give rise to the different bodies above noticed.

Dissection to trace the pyramid. *Dissection.* — To trace the fibres of the anterior pyramid, place the handle of the scalpel in the anterior median fissure, and separate the pyramids as low as their decussating fibres. Insert the instrument again below those cross fibres, and forcibly turn outwards on both sides the small part of the anterior column of the cord that remains (for the cord has been cut across just below), so as to expose the source of the decussating fibres.

Fibres of anterior pyramid. Each *anterior pyramid* receives fibres inferiorly from the anterior column of the cord of its own side, and internally from the lateral column of the opposite half of the cord. The inner set of fibres

Derivation have a deep origin, and as they come upwards to the surface, they push outwards the inferior fibres prolonged from the anterior column, and ascend internal to them. Moreover, the fibres of the lateral columns being directed to opposite sides, cross one another in the anterior median fissure of the spinal cord, forming the decussation of the pyramids.

and distribution. In the pyramid the fibres are white and longitudinal, and are collected into a bundle of a prismatic form. For the most part the fibres enter the pons, but two offsets proceed from the outer side. One is very small, and lying on the surface is directed below the corpus olivare to the restiform body; the other invests the olivary body, and receiving a band therefrom, enters the pons as the olivary fasciculus, or the fillet.

Olivary body The *olivary body*, when it is sliced obliquely, is seen to consist of a wavy yellowish line, surrounding a centre or nucleus of whitish

is an incomplete sac open behind. matter (corpus dentatum). The zigzag bounding line forms a capsule or bag, with the dilated part towards the surface, and the narrower part or neck, which is open, directed backwards. A

A band issues from it. band of fibres issues from the nucleus by the aperture in the posterior part of the capsule, and is united with the longitudinal fibres (of the pyramid) that invest the corpus olivare, to form the olivary fasciculus, or the *fillet.*

Dissection.—For the purpose of seeing the arrangement of the fibres of the lateral column and of the restiform body, cut across the anterior pyramid, on the left side, between its decussation and the olivary body, and raise the pyramid and that body together towards the pons. Afterwards detach the remaining part of the pyramid by dividing the fibres it receives from the decussation. Dissection of lateral and restiform pieces.

The *lateral column* of the cord, soon after entering the medulla oblongata, is divided into three sets of fibres, external, internal, and middle. The external fibres are both superficial and deep, and join the restiform body; the internal offset enters the pyramid of the opposite side; whilst the middle fibres, the continuation of the column, ascend beneath the olivary body, and leaving the surface are directed backwards to the floor of the fourth ventricle in their course to the cerebrum. Lateral fibres of cord are much mixed in medulla, and pass deeply.

The *decussation of the pyramids* is formed by the internal fibres of the lateral columns crossing one another in their course to the pyramids of opposite sides. This interweaving of the cross fibres occupies the anterior groove of the medulla oblongata, about three quarters of an inch from the pons, and is about a quarter of an inch in length. In it will be found three or four bundles of fibres from each side. Decussation of pyramids formed by band of fibres of lateral columns.

The *restiform body* receives inferiorly the posterior column of the cord, except that small part that forms the posterior pyramid. Some accessory fibres come to it from the lateral column and the anterior pyramid. Superiorly this body is continued altogether to the cerebellum, and does not enter the pons. Restiform body enters cerebellum.

The *posterior pyramid* is the upper end of the posterior median column of the cord. It is continued chiefly, if not altogether, to the cerebrum, by joining the fibres of the lateral column in the floor of the fourth ventricle. Posterior pyramid enters cerebrum.

The *grey matter* of the medulla oblongata is fused with the white fibres; but this disposition will be afterwards referred to with the anatomy of the fourth ventricle. Grey matter of medulla.

Arciform fibres.—Under this name are classed a few white fibres that cross the longitudinal ones near the pons, and enter the median fissure of the medulla. Oftentimes they cover a great part of the olivary and pyramidal bodies, but usually they are seen to form curves below the corpus olivare: hence the name used by Santorini. Arciform fibres.

Septum of the medulla.—If a hardened medulla oblongata is divided in the middle line, some septal fibres will be seen to pass from before backwards, above the position of the decussation of the pyramids: they appear to join the arciform fibres. Septum of medulla.

Pons: position, form, surfaces, and borders.

The PONS, OR ANNULAR PROTUBERANCE (pons Varolii, nodus encephali), is situate above the medulla oblongata, and between the hemispheres of the cerebellum, filling the hollow in front of the tentorium cerebelli. It is nearly of a square shape, though it is rather widest from side to side, and measures two inches in the last direction. The anterior surface is grooved along the middle line, and is received into the basilar hollow in the base of the skull. By the opposite surface the pons enters into the fourth ventricle, forming part of the floor of that space. The upper border is longest and most curved, and arches over the cerebral peduncles; and the lower border overlays the prolongations of the medulla oblongata. On each side is the crus cerebelli, whose fibres radiate over the surface.

It is formed by longitudinal and transverse fibres.

STRUCTURE. — In the pons, transverse and longitudinal fibres are combined: the transverse set are continuous with the fibres of the crus cerebelli, and are interspersed with much grey matter; the longitudinal are prolonged from the several constituent bodies of the medulla oblongata, except the corpus restiforme.

Dissection to expose the fibres.

Dissection. — Divide the transverse fibres over the line of the pyramidal body of the left side, and turn them outwards to expose the longitudinal fibres of the pyramid. Cut through in like manner a second mass of transverse fibres which lie below the first set of longitudinal ones, and the deep longitudinal fibres of the lateral column of the cord come into view. Amongst this last set of longitudinal fibres is the fillet of the corpus olivare, which the dissector should trace upwards from that body. The superficial fibres of the pons are seen on the side that is untouched.

The transverse fibres form a

The *transverse fibres* of the annular protuberance are collected into two layers — a superficial and deep, which are united in the middle line: they serve as commissural fibres of the cerebellum, and are derived from its crus or the middle peduncle.

superficial and

a. The superficial set are mostly transverse, but some from the lower part of the crus ascend obliquely over the others to reach the upper margin of the pons.

deep layer.

b. The deep layer is thickest, and contains much grey matter between the fibres.

The *longitudinal fibres* consist of three sets, viz. one from the anterior pyramidal body; another from the lateral and the posterior median column of the cord; and a third from the corpus olivare. Three sets of longitudinal fibres

a. The fibres of the anterior pyramid pass through the pons between the two sets of transverse fibres, but not as one mass, for they are divided into a number of small bundles in their progress. Much increased in number, at the upper border of the pons, the fibres enter the crus cerebri, and give rise to that surface of the peduncle which is now uppermost. from anterior pyramid

b. The ascending fibres of the lateral column of the cord are altogether deeper than the commissural fibres of the pons, and are mixed up with grey matter. More numerous than the preceding set, these fibres project in the floor of the fourth ventricle, where they form an eminence (fasciculus teres); and they are then continued upwards to the crus cerebri, of which they form the deeper or cerebral part. In the pons these fibres have the offset of the olivary fasciculus added to them, and lower down they are joined by the fibres of the posterior pyramidal body of the medulla oblongata. from lateral part of spinal cord, and posterior pyramid

c. The olivary fasciculus (fillet) divides into two slips in the pons. One passes backwards to the deeper part of the crus cerebri, and ends beneath the testis (one of the corpora quadrigemina). The other is continued to the cerebrum with the fibres of the lateral column. from olivary body.

Septum.—In the pons, as in the medulla oblongata, there are vertical or septal fibres between the halves, but only at the posterior part, for they are interrupted anteriorly by the union of the transverse or commissural fibres. Septum of pons.

Section IV.

THE CEREBRUM.

The cerebrum or great brain is the largest division of the encephalon; and it may be said to fill that part of the cavity of the skull which is above a circular line carried through the eyebrows and the occipital protuberance. Taking the general form of the skull, the cerebrum is convex on the upper aspect, and uneven on the lower aspect. It consists of two hemispheres, which are placed side by side, and are Situation and form of the cerebrum has two hemispheres

joined by median parts. partly separated by a median or longitudinal fissure; but the hemispheres are united in the middle line by certain interior parts (commissures), also by connecting structures at the under surface. Superiorly the surface of the hemisphere is entire, but inferiorly it is divided into lobes.

Under surface of cerebrum. A. Under Surface, or Base of the Cerebrum. — By the under part the cerebrum fits into the inequalities of the base of the skull; and on this aspect the separation into hemispheres is not so complete as on the upper surface, for the median fissure exists only in front and behind. The following parts are found at the base of the brain: —

Division of the hemisphere. On the under surface of each hemisphere, about one third from its front, is the fissure of Sylvius, which divides it into two. The anterior part is the anterior lobe; and the posterior large part is said to consist of middle and posterior lobes, the latter reaching forwards as far as the front of the cerebellum.

And parts along the middle line. In the middle line, in front of the pons, are the two large white masses — the peduncles of the cerebrum (crura cerebri), one belonging to each hemisphere; and between them is a space perforated by vessels (locus perforatus posticus). Outside the peduncle is the optic tract, and between it and the inner part of the hemisphere is a fissure leading into the lateral ventricle. Proceeding forwards in the middle line, the student will find two white bodies like peas (corpora albicantia); and in front of these is a greyish mass (tuber cinereum). From the tuber cinereum a conical reddish tube (infundibulum) descends to the pituitary body, in the sella Turcica of the sphenoid bone. Anterior to the same mass (tuber cinereum) are the converging optic tracts, with their commissure. Beneath the commissure of the optic nerves is a thin greyish layer (lamina cinerea); and still farther forwards is the anterior part of the great longitudinal fissure between the hemispheres, with the white corpus callosum in the bottom of it. At the inner end of the fissure of Sylvius is another spot perforated by vessels (locus perforatus anticus).

Parts of some special convolutions are now seen. One convolution, that of the corpus callosum (gyrus fornicatus), has its anterior part in contact with the body from which it takes its name; and its posterior part is on the outer side of the crus cerebri. Another is the convolution of the margin of the great median fissure, which is exposed at its anterior part, where the olfactory nerve is in contact with it. A third large convolution surrounds the fissure of Sylvius. Some other small convolutions will be examined with the Sylvian fissure. Parts of some convolutions.

The several parts of the base of the brain are now to be noticed more in detail.

Lobes of the cerebrum. — Usually there are three lobes described in each hemisphere. The *anterior* lobe is triangular in form, and the apex is turned backwards; it is somewhat excavated on the under surface, and is in contact with the orbital part of the frontal bone. The olfactory nerve lies near the inner margin. The *middle* lobe is the most prominent of the three, and projects into the middle fossa of the base of the skull. The fissure of Sylvius intervenes between it and the anterior lobe. The *posterior* lobe has no fissure of separation between it and the middle one; its extent forwards is determined by the anterior or outer margin of the cerebellum. This lobe is not in contact with the base of the skull, but is supported on the tentorium cerebelli. Three lobes in each hemisphere; anterior, middle, posterior.

The *fissure of Sylvius* is directed outwards between the anterior and middle lobes, and will be found to branch into two parts, one of which passes before and the other behind some small convolutions (island of Reil). At the inner extremity of the fissure is a narrowed part corresponding to a subjacent band of white fibres connecting the two lobes (fasciculus uncinatus). Fissure of Sylvius

Surrounding the cleft is the *convolution of the Sylvian fissure*, which is much bent as it makes the circuit; it is joined internally by the convolutions in the fissure, and externally by convolutions on the outer surface of the hemisphere of the cerebrum. is surrounded by a convolution,

The *island of Reil* consists of five or six small, short convolutions, which lie in the Sylvian fissure, and are concealed by the anterior and middle lobes in the natural condition of the parts. These convolutions are connected with the large convolution around the fissure. and contains other convolutions.

Crus cerebri is fixed in the under part of hemisphere.

Peduncle of the cerebrum (crus cerebri). This is a large, white, stalk-like looking body, which reaches from the upper border of the pons to the under part of the hemisphere of the same side near its inner margin. Each is about three quarters of an inch long, and widens as it approaches the cerebrum. Crossing its outer surface is the optic tract; and between the crus of opposite sides is the interpeduncular space, containing the locus perforatus, the corpora albicantia, and the tuber cinereum.

Formed of longitudinal fibres.

Structure. — The peduncle is formed by the longitudinal fibres of the pons, which enclose grey matter between them.

Dissection.

Dissection. — To trace the fibres on the left side, cut across in the pons the fibres continuous with the anterior pyramid, and raise and carry them forwards into the crus as far as the optic tract. In this proceeding the mass of grey matter (locus niger) is exposed, and beneath it is a second or deeper set of longitudinal fibres.

Its superficial fibres form crust;

a. The superficial fibres which form the cranial or free part of the crus, are continued from the anterior pyramidal body. They are longitudinal in direction, and coarse in texture, and are directed upwards to the cerebrum. The portion of the crus which is composed of these fibres is called the *fasciculated* part, or the *crust.*

deep fibres form tegmentum.

b. The deeper fibres are also prolonged to the cerebrum. They are derived from the lateral and posterior median columns of the cord, and from the olivary fasciculus (p. 179.), and are situate beneath the grey matter (locus niger). Besides being deeper, they are finer than the other set, and are interspersed with grey matter. The deeper part of the crus, viz. that at the cerebral aspect, is constructed by these fibres, and is named *tegmentum.*

The grey matter.

c. The grey matter of the crus (locus niger) is nearer the inner than the outer margin, and is convex towards the free surface, but concave in the opposite direction.

Locus perforatus.

The *posterior perforated spot* (pons Tarini) is situate between the peduncles of the cerebrum; it consists of greyish matter, into which numerous vessels enter. This structure forms part of the floor of the third ventricle.

Corpora albicantia.

The *corpora albicantia* (corp. mamillaria) are two small, white bodies, about the size of peas, which are formed in greater part by the crus of the fornix (to be afterwards seen). If one, say the left, is cut across, it will be found to contain grey matter; and grey matter also surrounds it.

The *tuber cinereum*, or the mass of grey matter behind the optic commissure, forms part of the floor of the third ventricle, and is continuous with the grey substance in that cavity. In front of it is the optic nerve, and from its centre projects the following: — The *infundibulum* (funnel) is a conically-shaped tube that reaches to the upper part of the pituitary body. In the fœtus this tube is open between the third ventricle and the pituitary body, but in the adult it is closed inferiorly. It consists of a layer of grey matter, surrounded by the pia mater, and lined by the membrane of the third ventricle as far as it is pervious. Tuber cinereum and infundibulum.

The *pituitary body* will be very imperfectly seen when it is removed from its resting-place: therefore it should be sometimes examined in the base of the skull, by removing the surrounding bone. Pituitary body.

This body is situate in the sella Turcica, or the hollow of the body of the sphenoid bone, and consists of two lobes, anterior and posterior. The anterior is the largest, and is concave behind, where it receives the posterior lobe. In the adult this mass is firm and solid, but in the fœtus it is hollow, and opens into the third ventricle through the infundibulum.

Dissection.—To see the lamina cinerea and the anterior termination of the corpus callosum, the convolutions of the anterior lobe of the cerebrum may be removed on the left side, where they overlay those parts. The convolution in contact with the corpus callosum (gyrus fornicatus) may be divided, and its ends turned forwards and backwards. Dissection.

The *lamina cinerea* is a thin layer of grey matter that extends backwards to the tuber cinereum, from the anterior termination of the corpus callosum. This structure closes the anterior part of the third ventricle, and shuts out the optic commissure from that space. Laterally it is continuous with the anterior perforated spot. In consequence of its great thinness, this structure is often broken through in removing the brain. Grey lamina.

The *corpus callosum* is seen to be bent in front, and then to be extended horizontally backwards in the longitudinal fissure nearly to the anterior commissure (within a quarter of an inch), where it presents a well-marked concave margin, Corpus callosum

ends inferiorly in two bands,

to which the lamina cinerea is joined. A white band, fillet, or peduncle of the corpus callosum is continued onwards, on each side, from the line of termination before alluded to, to the anterior perforated spot. To the anterior bend of the corpus callosum the term knee (genu) is applied, and the prolonged part is called beak (rostrum). Laterally, the corpus callosum reaches into the anterior lobe, bounding the lateral ventricle in the same direction, and an incision through it would open that cavity.

and extends laterally into hemisphere.

Its convolution,

In contact with the surface of the corpus callosum is the convolution named gyrus fornicatus, which begins by a narrow part in front of the anterior perforated spot. On the under part of the anterior lobe, at its inner margin, is also seen the beginning of the convolution of the margin of the longitudinal fissure. It contains the olfactory nerve in a sulcus. The upper part of these convolutions will be afterwards seen.

and that of longitudinal fissure.

Locus perforatus anticus.

Anterior perforated spot (locus perforatus anticus) is a space near the inner end of the fissure of Sylvius, which is situate between the anterior and middle lobes of the cerebrum, and in front of the optic tract. On the inner side it is continuous with the lamina cinerea, and crossing it from within outwards, is the fillet of the corpus callosum. This space is grey on the surface, and corresponds to the corpus striatum in the interior of the brain; it is perforated by the numerous vessels of that body.

Position of brain to examine upper part.

Position of the part. — Now the base of the cerebrum is dissected, the brain should be turned over for the examination of the upper part. After the brain is turned, something should be placed beneath the anterior lobes, to raise them to the same level as the posterior; and a rolled cloth should encircle the whole, to support the hemispheres.

Cerebrum is convex above, and divided into two.

B. Upper Surface of the Cerebrum. — On the upper surface, the cerebrum, taken as a whole, is oval in form, with the larger end backwards; and is convex in its outline, corresponding to the hollow of the skull. The median longitudinal fissure only partly separates the mass into two portions or hemispheres, for it is limited in the middle by the corpus callosum extending from one hemisphere to another.

Each hemisphere is smaller in front than behind. Its outer aspect is convex, but the inner is flat, and touches the opposite hemisphere in front. On the upper part the surface of the hemisphere is continuous, but on the under part it is separated into two pieces by the large cleft before seen. The superficies of the hemisphere is marked by tortuous eminences, having the appearance of a body bent and twisted in different directions, similar to the small intestine; the projections on it are named convolutions (gyri), and the intervening depressions, sulci or anfractuosities.

Each half

is marked by convolutions and sulci.

Convolutions.—Of the numerous convolutions the student may notice the following:—one of the corpus callosum, another of the margin of the longitudinal fissure, and others of the outer surface of the hemisphere.

Chief convolutions.

Dissection.—The upper part of each hemisphere having been already cut off as low as the convolution of the corpus callosum, cut through that convolution on the left side, and turn the ends forwards and backwards; a white longitudinal band (covered band of Reil) is seen beneath it. It is supposed that the top of one hemisphere has been kept for the purpose of examining the convolutions.

Dissection.

a. The *convolution of the corpus callosum* (gyrus fornicatus) extends around the root of each hemisphere, except across the fissure of Sylvius. It is narrow in front, and begins at the anterior perforated spot; then courses round the corpus callosum and the crus cerebri, and ends at the posterior part of the same spot. Whilst lying on the inner surface of the hemisphere, it is joined by the convolutions of that part. Beneath this convolution is a band of fibres (covered band of Reil, fillet of the corpus callosum), which is connected in front and behind with the anterior perforated spot, and gives offsets to other secondary convolutions in the longitudinal fissure.

Convolution of corpus callosum;

its fillet or band.

b. The *convolution of the margin of the longitudinal fissure* takes a similar course with the preceding around the hemisphere, but it lies at the margin of the great longitudinal fissure, instead of being placed deeply in it. Commencing at the anterior perforated spot, where it forms the inner part of the anterior lobe, it is directed back along the margin of the great fissure, and along the under part of the hemisphere to the front of the middle lobe. This is not so distinct as the preceding convolution.

Convolution of longitudinal fissure.

c. The *convolutions of the outer surface* of the hemisphere cross more or less obliquely from the convolution of the margin of the

Convolutions of outer

part of cerebrum. longitudinal fissure to that of the fissure of Sylvius. The posterior ones become most oblique and irregular. On opposite sides of the brain these convolutions are not symmetrical.

A convolution has base and summit; *Structure of the convolutions.*—From the section now made into the brain, it appears that each convolution is continuous with the interior of the brain on the one side (base), and that it is free on the surface of the brain on the other side, where it presents a summit and lateral parts. is grey outside Externally it consists of a layer of grey cerebral substance (cortical layer), which is continuous over the surface of the hemisphere; and white within. and internally it is composed of a white cerebral substance (medullary part), which is a prolongation from the fibres of the interior.

Sulci. The *sulci*, or the intervals between the convolutions, vary in size in different parts of the brain; they are deepest generally on the outer aspect of the hemisphere, where they measure about an inch.

The deepest where found. There is one of considerable depth on the inner surface of the hemisphere, on a level with the corpus callosum, which projects inwards beneath an eminence (hippocampus minor) in the floor of the lateral ventricle. From it another sulcus is directed vertically upwards to the convex part of the hemisphere.

Outline of the cerebrum C. INTERIOR OF THE CEREBRUM.—When viewed from the outer surface, the cerebrum appears to be a solid mass, but on making farther examination therein, it will be found to enclose a large irregular space, which is subdivided by partitions into smaller cavities or ventricles. composition. Further, each hemisphere is constructed of central or fundamental bodies, of a convoluted exterior, and of certain connecting internal pieces.

Fundamental bodies. The fundamental part of the hemisphere is formed by the crus cerebri and by two masses of grey substance (corpus striatum and optic thalamus), which are situate above the crus, and project into the lateral ventricle: the two last bodies are sometimes called ganglia of the brain, because the fibres of the peduncle, whilst passing through them, are increased in number. Crust or convoluted part The constituent fibres of the crust, or convoluted part of the hemisphere, may be said to begin inferiorly in the peduncle, and to spread out from that spot to

infold the central space before mentioned. And the connecting pieces, or fibres, which are named commissures, pass from hemisphere to hemisphere, across the middle line of the brain, or connect together the parts of the same half of the cerebrum : some of the commissural pieces serve as bounding parts of the ventricles. and commissures.

In conducting the dissection of the cerebrum, the student will have to learn the situation and the boundaries of the several cavities, to trace the fibres of the crus through the ganglia of increase to the convolutions, and to examine the commissures.

Internal character of the hemisphere above the ventricles.— In the right hemisphere, which has been cut through above the level of the convolution of the corpus callosum, the surface displays a white central mass of an oval shape (centrum ovale minus) that sends projections into the several convolutions. In a fresh brain, this surface is studded with drops of blood from the divided vessels. Centrum ovale minus of the hemisphere.

When the hemispheres are sliced off to the level of the corpus callosum, the white surface exposed is much larger, and is named larger oval centre (centrum ovale, Vieussens). The white mass in each hemisphere is further seen to be continuous across the middle line of the brain, where it is connected by a narrowed part, corpus callosum. Centrum ovale majus is deeper.

The *corpus callosum* reaches from the one hemisphere to the other, and forms the roof of each lateral ventricle. Between the hemispheres, this body is but of small extent, and occupies the longitudinal fissure. Here it is about four inches in length, and somewhat arched from before backwards ; it is also narrower in front than behind, and is nearer the anterior than the posterior part of the cerebrum. Corpus callosum. Situation and form.

On the upper surface of its free part the fibres are seen to be directed from the hemispheres to the middle line, the middle ones being transverse, but those from the anterior and posterior parts oblique. Along the middle is a mark (raphé), and close to it are two or more longitudinal white lines (nerves of Lancisi). Still further out may be seen other longitudinal lines beneath the convolution covering this body. The longitudinal fibres in the middle line are continued down- Upper surface has transverse and longitudinal fibres.

wards anteriorly, and join the prolongation (fillet) to the anterior perforated spot.

Anterior part bends down. In front, the corpus callosum is bent to the base of the brain, as before seen, and behind it ends in a thick roll, which joins the fornix beneath.

Dissection. *Dissection.*—In order to see the thickness of the corpus callosum, and the parts in contact with its under surface, the cut already made through the corpus callosum into the ventricle is to be extended forwards and backwards on the left side, as far as the limits of the cavity. In cutting through that body, a thin membrane may be observed to line its under surface.

Is thickest at each end. The corpus callosum is thicker at each end than at the centre, because of the greater number of fibres collected in a given space, and the posterior part is the thickest of all.

Under part. Connected with the under surface is the partition between the ventricles (septum lucidum), and still posterior to that is the fornix.

Is the transverse commissure. The corpus callosum is the chief commissural part of the brain, and reaches laterally even to the convolutions, but its fibres are not distinct far in the hemisphere.

Dissection. *Dissection.*—Open the lateral ventricle in the opposite hemisphere, and remove as much of the corpus callosum and of the white substance of the brain as may be necessary to see well the cavity. A part of the ventricle dips down in the middle lobe of the cerebrum towards the base of the brain, and to expose it, cut outwards through the left hemisphere, following down the hollow.

Five ventricles are in the brain. VENTRICLES OF THE BRAIN.—The ventricular spaces of the interior of the cerebrum are four in number, viz. one (lateral) in each hemisphere, another (third) in the middle line of the brain, near the under surface, and another small one (fifth) in the partition between the large ventricles of the hemispheres. The fourth ventricle is situate between the cerebellum and the posterior surfaces of the medulla oblongata and pons.

Lateral ventricle. The *lateral ventricles* are two in number, one in each hemisphere; they are separated in the middle line by a partition, and communicate by an aperture below that septum. The interior is lined by a serous membrane.

Each is a narrow interval in the hemisphere. Each has something of the shape of the italic letter *f*, and extends into the anterior, posterior, and middle lobes of the cerebrum; it is described as consisting of a central part or body, and three points or cornua. Shape and position;

Of the cornua of the ventricle:—the anterior turns outwards in the anterior lobe; the posterior (digital cavity) is much smaller in size, and is bent inwards in the posterior lobe, towards the one of the opposite side; and the inferior cornu, beginning opposite the posterior fold of the corpus callosum, descends in the middle lobe, and forms a curve like the half-bent fore-finger, the concavity being turned inwards. three cornua.

For the purpose of examining the boundaries, the ventricle may be divided into an upper or horizontal piece, and a lower or descending part. Consists of two parts.

a. The upper or horizontal part reaches from the anterior into the posterior lobe. One is horizontal. Its roof is formed by the fibres of the corpus callosum converging from the hemisphere. Its roof; Its floor is irregular in outline, and presents the following parts floor, from before backwards:—first, a small piece of the under part of the corpus callosum; and bodies along it. next a large grey, pear-shaped body (corpus striatum); then, behind this, another large white projection (optic thalamus); and between these two last bodies is a white line (tænia semicircularis). On the surface of the optic thalamus is a vascular fold of the pia mater (plexus choroides), together with the thin white edge of the fornix. Close behind the optic thalamus is the beginning of a projection in the floor of the descending part of the lateral ventricle, and in the posterior cornu is an elongated eminence (hippocampus minor). The inner boundary of the ventricle (septum ventriculorum) is a thin partition, Inner boundary. which is named septum lucidum; below the anterior part of the partition, opposite the front of the optic thalamus, is the aperture of communication between the ventricles (foramen of Monro). Aperture between.

b. The lower or descending part of the ventricle winds beneath the optic thalamus, and therefore this body with the The descending part; contiguous part of the hemisphere will form its roof. roof, In the floor is a large curved, convex eminence, somewhat indented floor,

at the end (hippocampus major), with a thin white band along its concave margin which is prolonged from the fornix. External to the projection of the hippocampus is another white eminence (pes accessorius, or eminentia collateralis). In this part of the ventricle is also seen the plexus choroides entering by a fissure internal to the hippocampus.

and bodies on it.

Septum lucidum; position, form, surfaces, borders, structure.

The *septum lucidum*, or the thin partition between the ventricles, is a translucent part of the cerebral matter which intervenes between the corpus callosum and the fornix, along the middle line. It is somewhat triangular in form, with the larger end turned forwards, and the narrow or pointed part directed backwards. Its surfaces look to the lateral ventricles. The upper border is attached to the under aspect of the corpus callosum along the centre; and the lower border is joined in part to the middle of the fornix, but in front of that body to the under or prolonged part of the corpus callosum. The septum consists of two layers, which enclose a space (fifth ventricle), and each layer is formed of white substance, with an external coating of grey matter.

Dissection.

Dissection.—Cut through the part of the corpus callosum that remains in the middle line, and raise forwards the anterior half by detaching it from the septum lucidum. By this proceeding the space of the fifth ventricle will come into view.

Fifth ventricle.

The *ventricle of the septum* (fifth ventricle) is found in the anterior part, where the depth of the partition is greatest, and like the septum that contains it, its largest part is in front. A serous membrane lines the cavity. In the adult it is distinct from the other ventricles, but in the fœtus it opens inferiorly into the third, between the pillars of the fornix.

Dissection.

Dissection. — Throw backwards the posterior part of the corpus callosum by breaking through the connection between it and the subjacent fornix. The septum lucidum is also to be detached from the front of the fornix.

Fornix; position and form.

The *fornix*, or arch, is a horizontal white layer beneath the corpus callosum, which is triangular in shape, the base being turned backwards; and it ends in two processes or crura, both before and behind.

Posterior and

The posterior part of the fornix joins the corpus callosum,

and sends off laterally a small riband-like band (tænia hippocampi) along the concave margin of the hippocampus major. The anterior part, or apex, is arched over the foramen of Monro, opposite the front of the optic thalamus, and ends in two processes or crura, which will be afterwards followed to the corpora albicantia and the optic thalami. To the upper surface, along the middle line, is attached the septum lucidum. Each border is free in the lateral ventricle, as it rests on the optic thalamus, and along it lies the choroid plexus. anterior part. Upper surface and borders.

If the fornix is cut across near its front, the foramen of Monro is opened, and the descending anterior pillars are seen. When the posterior part is raised from the membrane that supports it (velum interpositum), a triangular surface, which is marked by transverse and longitudinal lines, is seen on the under aspect, between the two offsets (tæniæ hippocampi); the surface which is so marked is called the lyra. Under surface marked by the lyra.

It would be more correct to describe the fornix as consisting of two bands, right and left, which are united for a certain distance in the central part or body. Each band commencing in the optic thalamus, passes above the foramen of Monro, and after forming the body of the fornix is continued as a separate piece to the surface of the hippocampus. Fornix formed of two bands.

The *foramen of Monro* is the aperture beneath the anterior part of the fornix, by which the lateral ventricles communicate with one another and with the third ventricle. The plexus choroides lies in it, and through it the serous lining of the ventricles is continuous. This aperture joins lateral ventricles.

Bodies in the Floor of the lateral Ventricle. — The student will leave, for the present, the membrane on which the fornix rests, and will examine on the left side the different bodies that have been enumerated in the floor of the lateral ventricle. In floor of lateral ventricle are

The *corpus striatum* (superior ganglion of the cerebrum, Gall) is the large grey body in the anterior part of the lateral ventricle, which has received its name from the striated appearance presented on a section being made through it. Externally it corresponds to the island of Reil in the fissure of Sylvius. striate body in front.

Dissection of its structure. *Dissection.* — To see the structure of the corpus striatum, the student should make a longitudinal cut in it until certain white fibres crossing it obliquely from within outwards are reached. The knife should then be carried through this layer of white fibres until another mass of grey substance, similar to the first, is arrived at.

Its form, The striate body now appears to be a conical mass of grey matter of considerable thickness, which is surrounded mostly by the white substance of the hemisphere, only a part projecting into the lateral ventricle. position; Its position is oblique with respect to the middle line of the brain, for the anterior part is near the septum of the ventricles, whilst the posterior part is external to the optic thalamus. is divided into two parts by large white fibres. From the incision that has been made into the corpus striatum, white fibres will be seen to be directed through it in such a way as to divide the mass of grey matter into two parts, one being situate in the ventricle above the white fibres (intra-ventricular), and the other outside the ventricular space, below those fibres (extra-ventricular).

One part in the ventricle, *a.* The *intra-ventricular* part of the striate body is pear-shaped, and projects into the floor of the ventricle. The larger end is directed forwards, but the opposite end is thin and pointed, and is continued backwards, outside the optic thalamus, to the roof of the descending cornu of the lateral ventricle. Numerous veins cover this part of the corpus striatum.

the other outside that cavity. *b.* The *extra-ventricular* part will be best seen afterwards by sections made from the outer side or from below. It is oval in form, but does not reach so far back as the other, and is bounded inferiorly by a white capsule; through it the anterior commissure of the brain passes, as will be seen in a subsequent dissection.

Tænia semicircularis The *tænia semicircularis* is a thin white band of longitudinal fibres between the corpus striatum and the optic thalamus. In front, this band becomes broad, and joins the pillar of the fornix; and behind it is continued with the pointed end of the corpus striatum into the white substance of the roof of the descending cornu of the lateral ventricle. ends in inferior cornu. Superficial to the anterior part of the tænia is a yellowish semi-transparent layer (lamina cornea), and beneath this some veins pass in their course to the veins of Galen.

Optic thalamus The *optic thalamus* is only partly exposed in this stage

of the dissection, and its examination may be omitted till after the third ventricle has been learnt.

The *hippocampus minor* (calcar avis) is pointed at its posterior extremity, and resembles a cock's spur as it lies in the posterior cornu of the ventricle. On the surface it is covered by the medullary layer of the corpus callosum, and when cut across it is found to be grey beneath, and to be produced by the extension inwards of the sulcus at the posterior part of the inner aspect of the hemisphere (p. 186.).

Hippocampus in posterior cornu; how formed.

The *hippocampus major* is the curved projection in the floor of the descending cornu of the lateral ventricle. Convex on the surface that looks to the ventricle, this body is curved in the same direction as the cornu, and has its concavity turned inwards. The anterior extremity is the largest, and presents two or three indentations, which give it the appearance of the foot of an animal (pes hippocampi). Along the inner or concave margin is the small band or tænia that is prolonged from the fornix; and beneath that band is a thin layer of grey matter with a notched border (fascia dentata).

Hippocampus major in lower cornu has a large end and jagged border.

Dissection. — To examine more fully the hippocampus, cut across the parts of the corpus callosum and fornix that remain in the middle line, and draw outwards the posterior lobe of the left hemisphere. When the pia mater is removed from the inner side of the hippocampus, and this projection is cut across, its structure is seen.

Dissection.

The hippocampus is covered on the surface by a medullary investment, in which the tænia, or the band of the fornix, ends. On the opposite aspect this body is hollowed, and receives grey matter from the surface of the brain. Along the free margin of the hippocampus the grey matter projects, and gives rise to the notched ridge, or the fascia dentata.

Structure of hippocampus.

Transverse fissure of the cerebrum.—By drawing the separated hemisphere away from the central parts of the cerebrum, viz. the crus cerebri and the optic thalamus, and by again replacing it, the dissector will understand the position and the boundaries of the great cleft at the posterior part of the brain. This fissure is placed beneath the fornix in the middle line, and extends thence downwards on each side, between the hemisphere and the crus cerebri, into the

Great transverse fissure is beneath fornix and corpus callosum

and reaches base of brain. descending cornu. Through this great slit the pia mater passes into the brain, forming the velum interpositum and the plexus choroides. Where the pia mater projects into the lateral ventricle beneath the edge of the fornix, the continuity of the serous membrane of that cavity is preserved by its reflection over the vascular fold.

Pia mater enters it.

Parts in the middle of brain. PARTS IN THE MIDDLE LINE OF THE CEREBRUM. — The student should now return to the examination of the parts in the centre of the brain, viz. the fold of pia mater and its vessels, the third ventricle, and the parts connected with it. At the same time the optic thalamus is to be seen.

Velum, or fold of pia mater, The *velum interpositum* is the central part of the fold of pia mater that enters the brain by the great transverse fissure. Triangular in shape, the membrane has the same extent as the body of the fornix, and reaches in front to the foramen of Monro. The upper surface is in contact with the fornix, and vessels pass between the two; but the lower surface forms the roof of the third ventricle, and covers the pineal body and a part of each optic thalamus. Along each side is a vascular roll of the membrane (choroid plexus).

is over third ventricle;

its lateral part is the choroid plexus of the lateral ventricle. The *choroid plexus* is the red, somewhat round, and fringed margin of the fold of pia mater in the interior of the brain. Its lower part is larger than the upper, and each is described as extending from the foramen of Monro to the extremity of the descending cornu. These bodies are supposed to be enveloped by the lining membrane of the lateral ventricle, and so excluded from the cavity of the serous membrane. On its surface the choroid plexus is villous; and the villi are subdivided, and covered by a layer of nucleated epithelium.

Vessels of the velum. *Vessels of the pia mater.* — *a.* Some small *arteries* have been already traced to the velum and the choroid plexus from the cerebral and cerebellar arteries (p. 166.). These supply branches to the surrounding cerebral substance. *b.* The *veins* of the choroid plexus receive branches from the ventricle, and end in the following. Along the centre of the velum are two large veins, *veins of Galen*, which begin at the foramen of Monro, by the union of veins from the corpus striatum and the choroid plexus. Lying side by side, these veins are usually united into one at the posterior part of the velum, which opens into the straight sinus.

Arteries; veins; with those of Galen.

Dissection. — When the velum interpositum is raised and thrown backwards, the third ventricle will be exposed. In reflecting the piece of pia mater, the student must be careful of the pineal body, which will otherwise be detached. On the under-surface of the velum are the choroid plexuses of the third ventricle. Dissection.

The *choroid plexuses* of the third ventricle are two fringed bodies beneath the velum, which resemble those parts in the lateral ventricle. Other choroid plexuses.

The *third ventricle* is an interval between the optic thalami, and reaches to the base of the brain. Its situation is in the middle line of the cerebrum, below the level of the other ventricles, with which it communicates. Its boundaries and communications are mentioned below. Third ventricle is near base of brain.

The roof is formed by the velum interpositum and the fornix. The floor is very oblique, so that the depth of the cavity is greater in front than behind. Corresponding to the floor are the parts at the base of the brain, which lie between the crura cerebri and the anterior longitudinal fissure, viz. locus perforatus, corpora albicantia, tuber cinereum, commissure of the optic nerves, and lamina cinerea. On the sides of the cavity the optic thalami are situate. In front of the space are the descending pillars of the fornix, with part of the anterior commissure of the cerebrum in the interval between them. Behind are the posterior commissure and the pineal body. Crossing the centre of the space from one optic thalamus to another, is a band of grey matter — soft commissure. Roof. Floor. Parts on the sides, in front, and behind.

This space communicates with the other ventricles of the brain in the following way: — In front it joins each lateral ventricle through the foramen of Monro, and opens into the fifth ventricle in the fœtus. Behind is an opening into the fourth ventricle, beneath the posterior commissure, which is named aqueduct of Sylvius. At the lower part, in front, there is a depression opposite the infundibulum (iter ad infundibulum), which is closed by the lining membrane. The serous membrane of the ventricle is continued into the neighbouring cavities through the different apertures of communication. Opening into other ventricles.

Grey matter of the ventricle. *Grey matter of the ventricle.* — At the lower part of each optic thalamus, the grey matter of the ventricle envelops the crus of the fornix, and ascends to the septum lucidum; moreover, it forms the soft commissure by extending from side to side. In the floor of the cavity it also exists in abundance, entering into the corpora albicantia, and uniting the structures that form the floor of the third ventricle.

Anterior commissure: form and extent. The *anterior commissure* of the cerebrum is a round bundle of white fibres, which passes through each corpus striatum, and connects the opposite hemispheres. To see it in one half of its extent, the student should make the following dissection: —

To see it, open corpus striatum. *Dissection.* — On the side on which the corpus striatum is cut into, follow the commissure into the interior of that body by scraping away the grey matter with the handle of the scalpel. The commissure will be then seen to perforate the white fibres of the corpus striatum, and to pass through the other mass of grey matter (extra-ventricular) of the same body.

Position; and course to roof of inferior cornu. Free only in the middle line, where it lies before the pillars of the fornix, the anterior commissure perforates the corpus striatum, passing in succession through the intra-ventricular grey part, the white fibres, and the extra-ventricular grey part. Lastly, the commissure pierces the white matter bounding externally the corpus striatum, and ends in the roof of the inferior cornu of the lateral ventricle.

Posterior commissure. The *posterior commissure* of the cerebrum is smaller than the anterior, and is placed above the opening into the fourth ventricle. Laterally it enters the substance of the optic thalamus.

Thalamus opticus. Form and position. The *thalamus opticus* (inferior ganglion of the cerebrum) is best seen on that side on which the inferior cornu of the lateral ventricle is opened. It is a square-shaped body, which forms part of the lateral and third ventricles, being free where it enters into those cavities.

Upper surface. Under part; The upper surface projects in the floor of the lateral ventricle, and is marked by a prominence in front (anterior tubercle) near the tænia semicircularis. The under surface forms part of the roof of the inferior cornu of the lateral ventricle, and into it the crus cerebri is inserted. By the

inner side this body enters into the third ventricle; and along the upper part of this aspect is the peduncle of the pineal body. On the outer side are the corpus striatum, and the substance of the hemisphere. The anterior part looks to the foramen of Monro. And the posterior part, which is free in the inferior cornu of the lateral ventricle, presents inferiorly two small roundish tubercles, internal and external geniculate bodies, with which the optic nerve is connected.

Inner side, outer side, anterior, and posterior parts,

The origin of the optic nerve from the thalamus, and from the geniculate and quadrigeminal bodies, is best seen now.

Origin of optic nerve.

Dissection. — Follow out now the origin of the fornix in the optic thalamus. First cut through the anterior commissure and the anterior part of the corpus callosum along the middle line; and separating the left hemisphere from the other, trace downwards the crus of the fornix to the corpus albicans, and then upwards into the optic thalamus.

Dissection.

Anterior pillar of the fornix.—The fornix begins in the thalamus opticus, near the tubercle on the upper surface. From this origin it descends in a curved direction to the corpus albicans, where it makes a turn like half of the figure 8, giving a white envelope to the grey matter of that body. The crus then ascends with a bend forwards through the grey substance on the side of the optic thalamus, and is joined by the fibres of the tænia semicircularis and peduncle of the pineal gland. Lastly, the crus is applied to the like part of the opposite side to form the body of the fornix.

Origin of fornix in optic thalamus; how forms corpus albicans. Joined by other fibres.

The *pineal body* and the *corpora quadrigemina*, which are placed behind the third ventricle, should be next examined.

Dissection. — All the pia mater should be carefully removed from the surface of the quadrigeminal bodies, especially on the left side, on which they are to be examined. The posterior lobe of the hemisphere of the same side may be cut off.

Dissection.

The *pineal gland* (conarium) is a small conical body, which is situate above the posterior commissure, and between the anterior pair of the corpora quadrigemina. In shape like the cone of a fir, it is less than a quarter of an inch in length, and has the base or wider part turned forwards. It is connected to the optic thalami by two white

Pineal gland; position, shape,

attachment to thalamus. bands, one on each side — peduncles of the pineal body: these begin at the base of the pineal gland, and extending forwards along the inner part of the optic thalami, end by joining the crura of the fornix. The base of the gland is further connected by transverse white fibres with the posterior commissure.

Structure. This body is of a red colour and vascular, and encloses a cavity; in it is a viscid fluid, with some calcareous particles.

Corpora quadrigemina. In pairs on each side. The *corpora quadrigemina* are four small bodies, which are arranged in pairs, right and left, and are separated by a median groove. Each pair is situate on the cerebral aspect of the peduncle of the cerebrum of the same side.

Anterior one (nates) joins thalamus. The anterior eminence (nates) is somewhat larger than the posterior, from which it is separated by a slight depression; it is oblong from before backwards, and sends forwards a white band to join the optic thalamus and the optic nerve.

Posterior one joins thalamus. The posterior eminence (testis) is rounder in form and whiter in colour than the preceding: it has also a lateral white band, which is directed beneath the corpus geniculatum internum, blending with the optic tract and the thalamus opticus.

Structure and their bands. These bodies are small masses of grey substance enveloped by white, and are situate over the band of the fillet that forms the roof of the aqueduct of Sylvius. They send processes to the optic thalamus (brachia), which are accessory parts to the peduncular fibres of the cerebrum.

Fillet of olivary body passes beneath corpora quadrigemina. *Fillet of the olivary body.* — If the upper margin of the cerebellum is pulled aside, a white band, about a quarter of an inch wide, is seen to issue from the transverse fibres of the pons, and to be directed upwards to the corpora quadrigemina. This is the upper or commissural piece of the fillet (p. 179.), which unites beneath the corpora quadrigemina, over the Sylvian aqueduct, with the similar part of the opposite side.

Three sets of fibres in cerebrum. STRUCTURE OF THE CEREBRUM. — In each cerebral hemisphere three principal sets of constituent fibres are recognised, viz. peduncular or diverging, and both transverse and longitudinal commissural.

Fibres of crus A. *Peduncular fibres.* — In the crus cerebri, or the root of the cerebral hemisphere, there are two bundles of longi-

tudinal fibres, which are kept distinct by grey matter, and are derived from different parts of the spinal cord (p. 182.). From this source the hemisphere may be said to spring. form the hemisphere.

Dissection.—To trace the fibres onwards beyond the crus cerebri, expose them first in the corpus striatum by scraping away the grey matter above them, and make this dissection on the side on which that body and the optic thalamus remain uncut. In this proceeding the pecten of Reil comes into view, viz. grey matter passing between the white fibres, and giving the appearance of the teeth of a comb. On taking away the prolonged part of the striate body, other fibres are seen issuing from the outer side of the optic thalamus, and radiating to the posterior and inferior lobes. Part of the upper surface of the optic thalamus, that at the posterior end, may be taken away to expose the accessory bundle coming to the peduncular fibres from the cerebellum (its superior peduncle) beneath the corpora quadrigemina. Dissection in the corpus striatum and optic thalamus.

The *peduncular fibres*, in ascending to the cerebrum, have the following disposition in the striate body and the optic thalamus. Those that form the free or fasciculated part of the peduncle pass through the middle of the striate body; whilst those on the opposite aspect of the peduncle, which form its tegmentum, are transmitted chiefly through the under part of the optic thalamus. In these two ganglionic bodies the fibres are greatly increased in number; and in the optic thalamus, they receive accessory bundles from the superior peduncle of the cerebellum, from the fillet of the olivary body, from one pair of the corpora quadrigemina, and from the corpora geniculata. On escaping from the striate body and the thalamus, the fibres radiate into the anterior, middle, and posterior parts of the cerebral hemisphere, forming the corona radiata. In the hemisphere the fibres are continued to the convolutions, but before reaching the circumference of the brain they decussate with the converging fibres of the corpus callosum. Their expansion in the hemisphere resembles a fan bent down in front and behind, forming thus a layer which is concave on the under side. Fibres of peduncle in corpus striatum and optic thalamus: their accessory bands. In the hemisphere they extend to convolutions.

B. The *transverse commissural fibres* connect the hemispheres of the cerebrum across the middle line. These fibres give rise to the great commissure (corpus callosum), and to the anterior and posterior commissures. All these bodies have been already examined. Commissural transverse fibres.

C. *Longitudinal fibres.*—Other connecting fibres pass Commissural

Longitudinal fibres. from before backwards, uniting together parts of the same hemisphere, and having mostly a circular arrangement.

Are found in fornix and its accessory parts; The longitudinal fibres are collected chiefly in the following different bands, viz. the fornix, the tænia semicircularis, and the peduncles of the pineal body. Other longitudinal fibres may also be enumerated on the upper and under surfaces of the corpus callosum, along the middle line, together with the band of the convolution of the corpus callosum. All these last are connected with the anterior perforated spot of the base of the brain.

and on, and under corpus callosum.

Optic thalamus differs above and below. *Structure of the optic thalamus.*—On making sections of the optic thalamus on the side on which it is entire (the left), this body will be found to consist of layers of grey and white substance at the upper and inner parts; but only of the medullary fibres (tegmentum) of the peduncle of the cerebrum at the lower and outer parts.

Section of corpus striatum from outside. *Corpus striatum.*—By slicing through the corona radiata on the right side, so as to expose the extra-ventricular part of the corpus striatum, the extent and form of that mass, and the situation of the anterior commissure, will be apparent.

Section of crus cerebri. *Crus cerebri.*—A section may be made through the right peduncle of the cerebrum, to see the disposition and the thickness of the two layers of its longitudinal fibres, and the situation of the locus niger between them.

Proceeding to prepare cerebellum. *Dissection.*—Detach the remains of the cerebrum from the cerebellum, by carrying the knife through the optic thalamus, and preserve in one piece the cerebellum with the corpora quadrigemina, the pons, and the medulla oblongata. Carefully remove all the pia mater from the fissure on the under surface of the cerebellum, and separate the different parts in that fissure. Let the handle of the scalpel be passed along a sulcus at the circumference of the cerebellum, between the upper and under surfaces.

Section V.

THE CEREBELLUM.

Form and position of cerebellum. The *cerebellum, little brain*, is flattened from above downwards; it is widest from side to side, and measures in this direction about four inches. This part of the encephalon is situate in the posterior fossæ of the base of the skull,

beneath the tentorium cerebelli. Like the cerebrum, it is divided into two hemispheres, the division being marked by a notch at the posterior part, which receives the falx cerebelli, and by a wide groove along the under surface. Divisions.

UPPER SURFACE. — On the upper aspect the cerebellum is raised in the centre, but is sloped towards the circumference. There is not any median sulcus on this aspect, but the halves are united by a central constricted part or isthmus (superior vermiform process). Separating this surface from the under one is the horizontal fissure, which is wide in front, and extends backwards from the pons to the middle line of the cerebellum. No groove on the upper surface; halves joined by median part.

The surface of the cerebellum is marked by plates or laminæ, instead of convolutions, which are notched on the sides, and form segments of circles arranged one within another, with their convexity directed backwards. On the upper aspect the laminæ pass from the one hemisphere to the other, with only a slight bending forwards of the most anterior in the superior vermiform process; but on the under aspect they join the sides of the different bodies in the median fissure (commissures). Between the laminæ are sulci or fissures, which are lined by the pia mater, and reach to different depths; of these the shallower ones separate the laminæ, but the deeper ones mark the lobes, and reach downwards to the white substance of the interior. Here and there the sulci are interrupted by cross laminæ. Laminæ and their arrangement. Sulci are shallow or deep.

The UNDER SURFACE is convex, being received into the fossæ of the skull, and is divided into hemispheres by a median hollow (vallecula, or valley). A fissure is present below,

The central depression, or the valley, receives the medulla oblongata, and is wider at the middle than at either the anterior or the posterior part. In the bottom of the hollow is a mass (inferior vermiform process), corresponding to the central part which connects the halves of the cerebellum on the upper surface; the two together constitute the general commissure of the halves of the cerebellum. which is called valley, and contains vermiform process.

Entering into the constitution of the inferior vermiform process are the following eminences, which will be easily separated from Constituents of vermi-

form process: one another with the handle of the scalpel:—Most anteriorly is a narrow body (uvula), which is named from its resemblance to the same part in the throat; it is longer from before backwards than from side to side, and is divided into laminæ. Its anterior projection into the fourth ventricle is named nodule, or laminated tubercle; and on its side is a ridge of grey matter, which is notched on the surface (furrowed band), and unites it with the almond-like lobe of the hemisphere. Connected to the nodule is a thin white layer on each side (medullary velum); but this and the furrowed band will be seen in a subsequent dissection. Behind the uvula is a tongue-shaped body (pyramid), which is elongated transversely, and is marked by transverse laminæ. Still farther back are certain transverse pieces extending between the posterior lobes of the hemispheres, of which they were considered by Reil to be the commissures.

Uvula, nodule, furrowed band, velum, pyramid, and commissures.

Seven lobes in each hemisphere, and three peduncles.

LOBES OF THE HEMISPHERE.—Each hemisphere is subdivided into lobes, both on the upper and the under aspect; and issuing from the anterior part is a large leg-like process, which is subdivided into three pieces, and connects the cerebellum with other parts, viz. an upper peduncle to the cerebrum, a middle one to the pons, and an inferior one to the medulla oblongata.

Two lobes on upper surface,

On the upper surface there are two lobes, but the sulcus between them is not well marked. One is the *anterior* or square lobe, which extends back as far as the vermiform process; and the *posterior* reaches thence to the great horizontal fissure at the circumference.

three on under surface, viz.

On the under surface of the cerebellum, where the concentric arrangement of the laminæ prevails, there are three lobes that are separated by sulci, but these are not more distinct than on the upper surface:—

biventral, slender, and posterior.

First, attached to the side of the pyramid, is the *biventral lobe*. Next follows the *slender lobe*, which is connected with the posterior part of the pyramid as well as with the other transverse laminæ behind that body. And, lastly, comes the *posterior lobe*, which joins the commissural laminæ behind the pyramid in the valley.

Two other lobes in valley.

Two other lobes appear between the biventral lobe and the medulla oblongata:—

Amygdaloid

One of these is the *amygdaloid lobe*, which projects into the

valley opposite the uvula, and touches the medulla oblongata. The other is a small pyramidal slip that is directed outwards over the crus cerebelli (now the under surface is uppermost), and is named *flocculus*, or subpeduncular lobe. and flocculus.

Dissection.—To see the flocculus and the posterior medullary velum, slice off, on the left side, the biventral and slender lobes of the under surface, and evert the amygdaloid lobe. Passing from the tip of the uvula to the flocculus is the thin white layer of the posterior velum, and beneath it a bit of paper may be put. The furrowed band on the side of the uvula is now seen. Dissection.

Flocculus and medullary velum.—The position of the flocculus to the crus cerebelli, and in front of the biventral lobe, has been before mentioned. This body resembles the other lobes in structure, and may be considered a rudimentary lobe, for it is divided on the surface into laminæ, and contains a white medullary centre that furnishes offsets to those divisions. Passing from the flocculus to the tip of the inferior vermiform process (nodule) is a thin white layer (velum), which serves as a commissure to the flocculi. This white band is semilunar in form, with the anterior edge free, and the posterior border fixed in front of the transverse furrowed band. In front of the nodule the pieces of opposite sides are united, and form the posterior medullary velum. Position and structure of flocculus. Posterior medullary velum. Form and attachments.

INTERIOR OF THE CEREBELLUM.—In the cerebellum there is not any cavity or ventricle enclosed, for the space of the fourth ventricle is between the cerebellum and the medulla oblongata. In the interior there is a large white centre, like that of the cerebrum, which furnishes offsets to the laminæ, and to other parts of the encephalon. Cerebellum is solid internally.

Dissection.—Turn upwards the superior aspect of the cerebellum, and make an incision across the laminæ of the left hemisphere to see their structure. On the right lobe place the scalpel in the horizontal fissure, and carry it inwards as far as the superior vermiform process, so as to cut away all the laminar structure, and expose the medullary substance with the contained corpus dentatum. Dissection.

Structure of the laminæ.—Each lamina consists of a white internal and a grey external substance. The white part is derived from the central medullary mass, and divides like the branching of a tree, until it ends in small lateral offsets that enter the subdivisions of the laminæ. The stratum of grey matter that envelops the white substance resembles the cortical covering of the convo- A lamina has white inside and grey outside

lutions of the cerebrum; it consists of two layers, of which the outer is grey, and the inner " dirty yellow."

Collateral white fibres. Besides the white stalk of the lamina which is derived from the central mass, there are other white fibres that pass from one lamina to another.

White centre of cerebellum. MEDULLARY CENTRE. — A large white mass occupies the centre of the cerebellar hemisphere, and contains in its substance a dentate body. gives offsets, viz. From its surface offsets are furnished to the different laminæ, and from the anterior part proceed three large processes or peduncles—superior, middle, and inferior.

superior peduncle *a*. The *superior peduncle* (processus ad cerebrum) is directed forwards towards the testis. It is rather flat in shape, and forms part of the roof of the fourth ventricle. Between the peduncles of opposite sides the valve of Vieussens is situate. is above fourth ventricle. Continuous behind with the inferior vermiform process, its fibres receive an offset from the interior of the corpus dentatum, and then pass beneath the pair of the corpora quadrigemina of the same side, and beneath the band of the fillet, to enter the optic thalamus.

Has valve of Vieussens between the two. Between the superior peduncles is a thin, translucent, white layer, the *valve of Vieussens* (velum medullare anterius), which forms part of the roof of the fourth ventricle. It is thin, and pointed anteriorly, but widens behind, and is connected with the under part of the vermiform process. Near the corpora quadrigemina the fourth nerve takes origin from the upper aspect of the valve, the nerves of opposite sides being united; and near the lower part the upper surface is marked by some grey transverse ridges.

Middle peduncle *b*. The *middle peduncle* (processus ad pontem) is commonly named crus cerebelli, and is the largest of the three peduncular masses. Its fibres begin in the lateral part of the cerebellum, and are directed forwards to the pons, of which they form the greater part, and in which they unite with the fibres of the peduncle of the opposite side. In is the commissure of cerebellum. this peduncle are the commissural fibres of the cerebellum, for which they are supposed to perform the same office as the corpus callosum does for the cerebrum.

Inferior peduncle. *c*. The *inferior peduncle*, or the restiform body (processus

ad medullam), passes downwards to the medulla oblongata. Its fibres are connected chiefly with the laminæ of the upper surface of the cerebellum. It will be better seen when the fourth ventricle is opened.

Corpus dentatum. The *dentate body* (corpus dentatum) is contained in the white fibres of the cerebellum, and resembles in structure the corpus olivare of the medulla oblongata. Situation and structure. This body measures three fourths of an inch from before backwards, and is situate nearest the inner part of the white centre. It consists of a wavy, greyish-yellow stratum, which is so arranged as to form a small capsule, open at the anterior part, and enclosing a nucleus of whitish matter. Through its aperture issues a band of fibres from the nucleus to join the superior peduncle.

Dissection. *Dissection.*—Cut through the middle of the vermiform process from above, and separate the halves of the cerebellum, in order that the structure of the central part, as well as the boundaries of the fourth ventricle, may be observed.

Vermiform process is like other parts. *Structure of the vermiform process.*—The vermiform processes of the cerebellum (upper and lower) are united in one central part, which connects together the hemispheres. Internally, the structure is the same as the rest of the cerebellum, viz. a central white stalk with lateral branches for the laminæ. Here the branching appearance of a tree (arbor vitæ) is best seen, in consequence of the stalks being longer and the laminæ more divided.

Fourth ventricle. The FOURTH VENTRICLE is a space between the cerebellum and the posterior aspect of the medulla oblongata and pons. Form and extent. It has the form of a lozenge, with the points placed upwards and downwards. The upper angle reaches as high as the upper border of the pons; and the lower, to a level with the inferior part of the olivary body.

Roof. The roof of the space is somewhat arched, and is formed by the valve of Vieussens, by the under part of the vermiform process, and lastly, by the reflection of the pia mater of the spinal cord to the surface of the vermiform process.

Floor. The floor of the ventricle corresponds to the posterior surfaces of the medulla oblongata and pons. Parts in it are, calamus, Along its centre is a median groove (calamus scriptorius), which is in a line with the posterior fissure of the spinal cord; and at its

lower end, near the swollen part of the posterior pyramid, is a minute hole, — the remains of the canal of the cord. On each side of the groove is an elevation, which is grey and little marked inferiorly, but becomes whiter and more prominent as it ascends. This eminence is the fasciculus teres, and consists of the longitudinal fibres of the lateral tracts or columns of the cord ascending to the crus cerebri (p. 179.). Crossing the floor, about the middle, are some white striæ that issue from the median groove: one or two of these are connected with the origin of the auditory nerve, but others pass obliquely outwards. Below these transverse lines the surface is more irregular; and on each side is an oblique groove that extends a short distance from the middle line, and points out three slight prominences on this part of the floor: one being above the groove, another below it, and a third at its outer termination. These eminences mark the situation of masses of grey matter which are supposed by Stilling to give origin to the eighth and ninth nerves.

fasciculus teres, white striæ. A slight fissure and three eminences.

Lateral boundary. The lower half of the lozenge-shaped space of the ventricle is bounded laterally by the restiform body diverging to the cerebellum and by the posterior pyramid; and the upper half has the superior peduncle of the cerebellum as its limit on the side. Along the line of union of the peduncle with the floor is a linear mass of dark grey matter, into which one or more of the oblique lines on the floor may sometimes be seen to dip.

Openings of the ventricle This ventricle communicates at the upper part with the third ventricle by the Sylvian aqueduct; and with the subarachnoid space of the cord and brain by an aperture in the pia mater that intervenes between the medulla and the cerebellum. The serous lining of the other ventricles is prolonged into this by the aperture of communication with the third; and in this cavity, besides investing the ventricular surface, it forms laterally a pouch on the under surface of the hemisphere beneath the eighth nerve.

and its serous lining.

Choroid plexus of the cavity. In the fourth ventricle is a vascular fold, or a choroid plexus, on each side, similar to the body of the same name in the other ventricles. It is attached to the inner surface of the membrane (pia mater), that closes the ventricle

between the medulla and the cerebellum, and it extends upwards on the side. Its vessels are supplied by the inferior cerebellar artery.

Grey matter of the medulla oblongata. — In the medulla oblongata the grey matter of the cord is altered in its disposition, and is blended with the longitudinal fibres, except those of the anterior pyramid. In the lower part of the floor of the fourth ventricle, the transverse or commissural part of the grey substance of the cord is left exposed by the divergence of the posterior columns of the cord from the middle line, and it is diffused and mixed with the fibres of the fasciculus teres: where it is so exposed on the surface of the ventricle, it is covered by a thin translucent layer of white matter. Further, the posterior horn of the grey crescent in the half of the cord forms a mass in the restiform body (grey tubercle of Rolando), and is blended with the fibres of that body.

Grey matter of medulla oblongata differs from that of the cord.

According to Stilling there are special masses or nuclei of grey matter in the medulla oblongata, with which the origins of the eighth and ninth nerves are connected. These masses are placed at the lower part of the floor of the fourth ventricle, where they form the three small eminences before alluded to (p. 206.). The external nucleus gives origin to the glosso-pharyngeal nerve, the internal one to the hypoglossal, and the lowest eminence to the vagus nerve. Another mass for the spinal accessory nerve is lower down, and is contained in the substance of the cord.

Stilling says it forms nuclei for eighth and ninth nerves.

TABLE OF THE CHIEF ARTERIES OF THE HEAD AND NECK.

Arch of the aorta gives to the neck,

- 1. Brachio-cephalic
  - 1. Common carotid -
    - 1. External carotid.
      - 1. Superior thyroid - Hyoid branch, laryngeal, thyroid.
      - 2. lingual - - - Hyoid branch, dorsal lingual, sublingual, ranine.
      - 3. facial - - -
        - Inferior palatine branch
        - tonsillitic
        - glandular
        - submental
        - inferior labial
        - coronary - inferior, superior
        - lateral nasal
        - angular.
      - 4. occipital - - Meningeal branch, posterior cervical.
      - 5. posterior auricular - Stylo-mastoid branch, Auricular, mastoid.
      - 6. ascending pharyngeal - Pharyngeal branches, meningeal.
      - 7. temporal - - auricular, parotid, articular, transverse facial, middle temporal, anterior temporal, posterior temporal.
      - 8. internal maxillary - Inferior dental, middle meningeal, muscular, posterior dental, infra-orbital, spheno-palatine, descending palatine, vidian, pterygo-palatine.
    - 2. Internal carotid
      - 1. Arteriæ receptaculi
      - 2. ophthalmic - - Lachrymal, supra-orbital, central of the retina, ciliary, muscular, ethmoidal, palpebral, frontal, nasal.
      - 3. anterior cerebral
      - 4. anterior communicating
      - 5. middle cerebral
      - 6. posterior communicating
      - 7. choroid -
  - 2. subclavian -
    - 1. Vertebral - Anterior spinal, posterior spinal, inferior cerebellar, posterior meningeal, transverse basilar, anterior inferior cerebellar, superior cerebellar, posterior cerebral.
    - 2. internal mammary
    - 3. thyroid axis
      - Inferior thyroid - - Ascending cervical.
      - supra-scapular - - Supra-spinal, infra-spinal.
      - transverse cervical - Superficial cervical, posterior scapular.
    - 4. deep cervical - superior intercostal.
- 2. left common carotid.
- 3. left subclavian.

TABLE OF THE CHIEF VEINS OF THE HEAD AND NECK.

Brachio-cephalic is formed by the union of -

- Internal jugular -
  - 1. Lateral sinus -
    - Superior longitudinal sinus
    - inferior longitudinal sinus
    - straight sinus
    - occipital sinuses
    - ophthalmic vein
    - superior petrosal
    - inferior petrosal.
  - 2. ascending pharyngeal -
    - Meningeal branches
    - pharyngeal.
  - 3. lingual -
    - Superficial dorsal
    - lingual
    - ranine.
  - 4. facial -
    - Angular - -
      - Supra-orbital
      - frontal
      - palpebral
      - nasal.
    - inferior palpebral
    - dorsal and lateral nasal veins
    - alveolar - -
      - Alveolar branches
      - infra-orbital
      - descending palatine
      - spheno-palatine
      - vidian.
    - coronary
      - superior
      - inferior
    - buccal
    - masseteric
    - labial
    - submental
    - inferior palatine
    - tonsillitic
    - glandular.
  - 5. occipital -
    - Mastoid vein
    - cervical.
  - 6. superior thyroid -
    - Thyroid
    - laryngeal.
  - 7. middle thyroid.
- subclavian -
  - 1. Vertebral
    - Spinal
    - deep cervical
    - ascending cervical.
  - 2. external jugular -
    - 1. Internal maxillary
      - Middle meningeal
      - inferior dental
      - deep temporal
      - pterygoid
      - masseteric.
    - 2. temporal - -
      - Anterior
      - posterior
      - middle temporal
      - parotid
      - anterior auricular
      - transverse facial.
    - 3. posterior auricular
      - Auricular
      - stylo-mastoid.
    - 4. branch of the internal jugular
    - 5. supra-scapular -
      - Supra-spinal
      - infra-spinal.
    - 6. transverse cervical
      - Superficial cervical
      - posterior scapular.
  - 3. anterior jugular.
  - 4. superior intercostal of the right side.

TABLE OF THE CRANIAL NERVES OF THE HEAD AND NECK

- 1. First or olfactory nerve - Filaments to the nose.
- 2. Second or optic nerve - To the retina of the eye.
- 3. Third or motor nerve of the eyeball - To the muscles of the orbit.
- 4. Fourth nerve - Meningeal branches and to the superior oblique muscle.
- 5. Fifth or trifacial nerve
  - Ophthalmic -
    - Meningeal.
    - lachrymal - Lachrymal, palpebral, communicating.
    - frontal - Supra-orbital, supra-trochlear.
    - nasal - To lenticular ganglion, ciliary nerves, infra-trochlear, nasal.
  - ophthalmic or lenticular ganglion -
    - Connecting branches - To nasal of the fifth nerve, to the third nerve, to sympathetic.
    - branches of distribution - Ciliary nerves.
  - superior maxillary -
    - Orbital branch - Subcutaneous, malar, temporal.
    - branches to Meckel's ganglion
    - posterior dental
    - anterior dental
    - infra-orbital.
  - Meckel's ganglion -
    - Internal branches - Nasal, naso-palatine.
    - ascending - To the orbit.
    - descending - Anterior, posterior, external - palatine.
    - posterior -
      - Vidian - Carotid branch, large petrosal nerve.
      - pharyngeal.
  - inferior maxillary -
    - Small or muscular division - Deep temporal, masseteric, buccal, pterygoid.
    - large or inferior division -
      - Auriculo-temporal - Communicating, articular, and to meatus, parotid, auricular, temporal.
      - gustatory - Branches to mucous membrane, to sub-maxillary and sub-lingual ganglia, to hypoglossal, to the tongue.
      - inferior dental - Mylo-hyoid, labial, incisor.

TABLE OF THE CRANIAL NERVES—*continued.*

- Fifth or tri-facial nerve, *continued.*
  - otic ganglion -
    - Connecting branches
      - Small petrosal, to Jacobson's nerve
      - to the fifth and sympathetic nerves.
    - Branches of distribution - -
      - To the tensor palati muscle
      - nerve to the tensor tympani.
  - sub-maxillary ganglion - -
    - Connecting branches
      - To the gustatory, chorda tympani, and sympathetic nerves.
    - branches of distribution - -
      - To the gland
      - to the mucous membrane of the mouth, and Wharton's duct.

- Sixth nerve -
  - To the external rectus muscle of the orbit.

- Seventh nerve
  - Portio dura - -
    - Connecting branches -
      - To join auditory
      - others to join Meckel's ganglion
      - tympanic and sympathetic nerves
      - the chorda tympani.
    - Branches of distribution -
      - Posterior auricular
      - digastric branch
      - stylo hyoid branch
      - temporo-facial -
        - Temporal
        - malar
        - infra-orbital.
      - cervico-facial -
        - Buccal
        - supra-maxillary
        - infra-maxillary.
  - portio mollis - - - -
    - To join the portio dura
    - the nerve to the cochlea
    - the nerve of the vestibule gives branches -
      - To the common sac
      - to the saccule
      - to the semi-circular canals.

- Eighth nerve
  - Glosso-pharyngeal -
    - Connecting branches -
      - To vagus
      - to sympathetic in neck
      - Jacobson's nerve -
        - Joins sympathetic
        - large petrosal nerve
        - the otic ganglion, and
        - supplies tympanum.
      - to the facial nerve.
    - Branches of distribution -
      - To carotid artery
      - to the pharynx
      - tonsillitic branches
      - muscular
      - lingual.

TABLE OF THE CRANIAL NERVES OF THE HEAD AND NECK.

- 3. Eighth nerve *continued.*
  - pneumo-gastric -
    - Connecting branches -
      - To the spinal accessory
      - glosso-pharyngeal
      - sympathetic and auricular nerves
      - to the hypoglossal
      - to the spinal accessory.
    - Branches of distribution -
      - Pharyngeal nerve
      - superior laryngeal -
        - External laryngeal
        - ascending / descending — to the mucous membrane
        - nerve to join the inferior laryngeal.
      - cardiac nerves
      - inferior laryngeal -
        - Cardiac
        - œsophageal and tracheal
        - to inferior constrictor and muscles of the larynx
        - to join superior laryngeal.
  - spinal accessory -
    - Connecting branches -
      - To the pneumo-gastric
      - to the cervical plexus.
    - Branches of distribution -
      - to sterno-mastoideus
      - trapezius.
- 9. Ninth or hypoglossal nerve -
  - Connecting branches -
    - To the pneumo-gastric nerve
    - to the sympathetic
    - to the loop of the atlas.
  - Branches of distribution -
    - Descendens noni nerve
    - thyro-hyoid nerve
    - branches to the gustatory nerve
    - to the lingual muscles and to the tongue.

TABLE OF THE SPINAL AND SYMPATHETIC NERVES OF THE HEAD AND NECK.

Spinal Nerves.

- The cervical spinal nerves divide into
  - Anterior branches -
    - The first four form the CERVICAL PLEXUS, which gives off - -
      - Superficial ascending
        - Small occipital nerve
        - great auricular
        - superficial cervical.
      - superficial descending
        - Supra-acromial
        - supra-clavicular
        - supra-sternal.
      - deep internal - -
        - To the pneumo-gastric
        - to the hypoglossal
        - to the sympathetic
        - to rectus major muscle
        - phrenic nerve
        - nerves to the descendens noni.
      - deep external - -
        - To join the spinal accessory
        - to the sterno-mastoideus
        - to the trapezius
        - to the levator anguli scapulæ.
    - The last four and first dorsal form the BRACHIAL PLEXUS, which gives off - - -
      - Branches above the clavicle -
        - The rhomboid nerve
        - to the phrenic nerve
        - supra-scapular nerve
        - subclavian branch
        - posterior thoracic or respiratory
        - to the scaleni muscles.
      - branches below -
        - Are dissected with the upper limb.
  - posterior branches -
    - Are distributed to the muscles of the back, and give off cutaneous nerves.

Sympathetic Nerve.

- The [illegible] of sympathetic nerve has in the neck
  - 1. Superior cervical ganglion has - -
    - Ascending branches, which unite in plexuses - -
      - Carotid plexus which gives
        - Branch to Jacobson's nerve
        - to the vidian
        - to the sixth cranial nerve.
      - cavernous plexus, which gives branches - -
        - To the third cranial nerve
        - to the fourth cranial nerve
        - to the fifth and lenticular ganglion
        - to the carotid artery and branches.
    - external branches -
      - To join pneumo-gastric and hypoglossal nerves
      - to the spinal nerves.
    - internal branches -
      - Pharyngeal branches
      - superficial cardiac nerve.
    - branches to vessels - Nervi molles.
  - 2. Middle cervical ganglion -
    - External branches - To the spinal nerves.
    - internal - - -
      - Middle cardiac nerve
      - to supply thyroid body and join the external laryngeal.
  - 3. Inferior cervical ganglion -
    - Anterior branches - To the subclavian artery.
    - external - - - To the spinal nerves, forming vertebral plexus.
    - internal - - - Inferior cardiac nerve.

CHAPTER III.

DISSECTION OF THE UPPER LIMB.

SECTION I.

THE AXILLA AND THE WALL OF THE THORAX.

Direction for the dissection.

THE parts included in Section I., viz. the wall of the thorax and the axilla, are to be dissected within a fixed time, in order that the examination of the chest may be undertaken.

Position of body.

Position. — Whilst the body lies on the back, let the dissector raise the thorax to a convenient height by a block, and carry the arm from the trunk, rotating it slightly outwards at the same time. Before the dissection is begun, attention should be given by the student to certain depressions on the surface, and to the prominences of muscles, or of points of bone.

Marking of surface. Arm-pit.

Surface-marking. — Between the arm and chest is the hollow of the arm-pit, which contains the large vessels and nerves of the limb. The extent of this hollow may be seen to depend upon the position of the limb to the trunk; for in proportion as the arm is elevated, the boundaries are carried upwards, and rendered tense, and the depth of the space is diminished. The skin here is of a dark colour, and is furnished with hairs, and large sweat glands. If the arm is forcibly raised whilst the fingers of one hand are placed in the arm-pit, the head of the humerus may be recognised.

Shoulder.

On the outer side of the limb is the prominence of the shoulder, and immediately above it is an osseous arch, which is formed internally by the clavicle, and externally by the spine and acromion process of the scapula. Continued downwards from about the middle of the clavicle, between the pectoral and deltoid muscles, is a slight depression, in which the coracoid process can be felt near the clavicle. A

second groove is sometimes seen extending outwards from the sternal end of the clavicle, between the clavicular and sternal origins of the great pectoral muscle.

Along the front of the arm is the prominence of the biceps muscle, and on each side of that muscle is a groove, which subsides inferiorly in a depression in front of the elbow-joint. The inner of the two grooves is the most marked, and corresponds to the position of the brachial vessels. Arm.

If the elbow-joint is semiflexed the prominences of the outer and inner condyles of the humerus will be rendered evident, especially that on the inner side of the limb. Below the outer condyle, and separated from it by a slight interval, is the projection of the head of the radius, which will be recognised by rotating this bone, the fingers at the same time being placed over it. At the back of the articulation is the prominence of the olecranon. Elbow-joint.

Dissection. — The dissection is to be begun by raising the skin from the side of the chest and from the arm-pit. The student is to make an incision along the middle of the sternum (its whole length); to extend the same along the clavicle for two thirds of the length of that bone, and to continue it down the arm as low as the fold of the arm-pit. From the xyphoid cartilage let two other cuts be made: one should extend along the anterior fold of the arm-pit till it nearly joins the first cut, and then across the inner part of the arm to the posterior fold of the axilla; the other is to pass horizontally outwards over the side of the chest, as far back as to a level with the posterior fold of the arm-pit. The two flaps now marked out should be reflected outwards, and be left attached to the body, in order that they may be afterwards used for the preservation of the part. Dissection to raise the integument.

The *subcutaneous fasciæ* of the thorax resemble the same structures in other parts of the body; but here the superficial layer does not contain much fat. Beneath the first layer is a deeper and stronger special fascia that closely invests the muscles, and is continuous with the deep fascia of the arm. It is thin on the side of the chest, but becomes much thicker where it is stretched across the axilla. An incision through it, over the armpit, will demonstrate its increased strength in this situation, and its connections with the folds of the axilla. Fasciæ.

Dissection of cutaneous nerves of the chest.

Dissection.—The cutaneous nerves of the side of the chest are to be sought in the fat. Some of these (from the cervical plexus) are found crossing the clavicle at the middle and at the inner part; others (anterior cutaneous of the thorax) appear at the side of the sternum, one from each intercostal space; and others (lateral cutaneous of the thorax) will be found along the side of the chest, about one inch below the anterior fold of the axilla, there being one from each intercostal space except the first. As soon as the last mentioned nerves appear they are divided into an anterior and a posterior branch. In the two highest the posterior branches are larger than the rest, and are to be followed across the arm-pit, where a junction takes place with a branch (nerve of Wrisberg) of the brachial plexus.

Descending cutaneous nerves of cervical plexus.

The descending *cutaneous nerves of the cervical plexus*, that cross the clavicle, are distributed to the integuments over the pectoral muscle. The most internal branch (sternal) lies near the inner end of the bone, and reaches but a short distance below it. Other branches, two or more in number, and of larger size (clavicular), cross the centre of the clavicle, and extend to near the lower border of the pectoralis major; these join one or more of the anterior cutaneous nerves of the thorax.

Cutaneous branches of the intercostal nerves. Are in two rows.

The *cutaneous nerves of the thorax* are derived from the trunks of the intercostal nerves between the ribs. Of these there are two sets: one, the lateral cutaneous nerves of the thorax, arise from the trunks of the nerves about midway between the spine and the sternum: the other set, the anterior cutaneous nerves of the thorax, are the terminations of the same trunks at the middle line of the body.

One along middle line.

The *anterior cutaneous nerves* are directed outwards in the integuments in the form of slender filaments. The offset of the second nerve joins a cutaneous branch of the cervical plexus, and the others below supply the mammary gland and the integuments. Small cutaneous branches of the internal mammary vessels are found with these nerves.

The other on side of chest. These have

The *lateral cutaneous nerves* divide immediately into an anterior and a posterior branch. There is not usually any lateral cutaneous nerve to the first intercostal trunk, and that of the second intercostal wants the anterior branch of bifurcation.

anterior and

a. The *anterior branches* bend forwards over the pectoral muscle, and furnish offsets to the mammary gland and the integuments. The lowest also give twigs to the digitations of the external oblique muscle.

b. The *posterior branches* are distributed to the integuments over the latissimus dorsi muscle and the back of the scapula. The branch of the second intercostal nerve is larger than the rest, and perforating the fascia of the axilla, supplies the integument of the arm, from which circumstance it is named *intercosto-humeral.* As it crosses the axilla it is divided into two or more pieces, and is connected to the nerve of Wrisberg by a filament of variable size. The branch of the third intercostal also gives filaments to the arm-pit and the inner part of the arm.

Posterior branches.

One or more of this set reaches the arm.

The MAMMA, or the breast, is the gland for the secretion of the milk, and is situate on the front of the chest towards the lateral aspect.

Office of the breast.

The gland is hemispherical in form, though rather more prominent on the inner side towards the lower part, and is placed over the great pectoral muscle. Its dimensions and weight vary greatly. In a breast that is not enlarged by lactation, the mamma measures commonly about four inches in each direction, extending longitudinally from the third to the sixth or seventh rib, and transversely from the side of the sternum to the axilla. Its depth is about one inch and a half. The weight of the breast ranges from six to eight ounces.

Form and position;

with its dimensions

and weight.

Nearly in the centre of the gland (rather to the inner side) is the conical or cylindrical projection of the nipple (mamilla), which is slightly turned outwards. It is about half an inch or rather more in length, and presents in the centre a slight depression, where it is likewise rather redder. Around the nipple is a coloured ring (areola) about an inch in width, whose tint is influenced by the complexion of the body, and during life by the states of menstruation, pregnancy, and lactation. The skin both of the nipple and its areola is provided with numerous papillæ and lubricating glands; and on the surface are some tubercles marking the position of the ducts of those glands.

Position and form of the nipple

and the areola.

Colour is altered.

Skin has glands.

In the male the mammary gland resembles that of the female in general form; for it is prominent, though in a much less degree, and it possesses a small nipple, which is surrounded by an areola provided with hairs. Farther than this the similitude does not hold, for the glandular or secretory structure is very imperfect.

Breast of the male.

Structure.—In its texture the mamma resembles those

Structure.

compound glands that are formed by the vesicular extremities of branched ducts. During lactation the glandular mass is of a reddish white colour, and consists of small vesicles, which are united to form lobules and lobes. Connected with each lobe is an excretory or lactiferous duct; and the whole is surrounded, and bound together by areolar tissue.

Investing cellular layer.

A *cellular layer*, containing fat, surrounds the gland, and penetrates into the interior, subdividing it into lobes. Some fibrous septa fix the gland to the skin, and support it; these are the ligamenta suspensoria of Sir A. Cooper. In the ultimate structure of the gland, in the nipple, and in the areola, there is not any fatty substance.

Texture and form of the vesicles.

Vesicles, lobules, and lobes. — The little vesicles or cells in which the most minute ducts begin are lenticular or rounded in shape, and when filled with milk or mercury are just visible to the naked eye, being about the size of a small pin-hole in paper.—(Cooper.) Each is surrounded externally by a close vascular network. A collection of the vesicles around their duct forms the smallest divisions of the gland, viz. lobules or glandules, which vary in size from a pin's head to a small tare. By the union of lobules the lobes are produced, of which there are about twenty altogether, and each is provided with a distinct duct.

The lobules are formed of vesicles, and the lobes of lobules.

Lactiferous ducts;

The *ducts* issuing from the several lobes, about twenty in number, converge to the areola, where they swell into oblong dilatations or receptacles (sacculi) of one-sixth to one-third of an inch in width. Onwards from that spot the ducts become straight, and are continued through the nipple, nearly parallel to one another, and gradually narrowing in size, to open on its summit by apertures varying from the size of a bristle to that of a common pin. Like other excretory ducts, the milk tubes consist of an external or fibrous, and an internal or mucous coat; they are sheathed also by a scaly or pavement epithelium. In the nipple the ducts are surrounded by fibrous tissue.

open on end of nipple. Structure.

Small glands of skin.

Some of the lubricating *glands* beneath the skin of the nipple and the areola are ordinary sebaceous glands, but others are larger aggregate glands that open in the tubercles before mentioned.

Arteries of the gland

Bloodvessels, nerves, and lymphatics. — The *arteries* of the breast are supplied by the axillary, internal mammary, and intercostal arteries, and enter both surfaces of the organ. The vessels on the cutaneous surface supply branches to the nipple, which pass from base to apex, being nearly parallel. The *veins*, after issuing from the substance of the breast, are thus disposed:—some form a plexus on the anterior

and veins

aspect, and a circle around the areola, and end principally in the axillary and internal mammary trunks; but others enter one or more of the intercostal veins, or ascend over the clavicle to join the veins of the neck. In the nipple the veins have an arrangement like that of the arteries, the two forming the erectile structure of that part. The *nerves* are supplied from the anterior and lateral cutaneous nerves of the thorax, viz. those of the third, fourth, and fifth intercostal nerves. The *lymphatics* pass either from the inner or the outer part of the gland: at the former side they accompany the branches of the internal mammary artery, and open into the anterior mediastinal glands, and on the latter they reach the axillary glands.

form erectile structure in nipple

Nerves.

Lymphatics.

Dissection. — With the arm in the same position with respect to the trunk, the student is first to remove the fascia and the fat from the surface of the great pectoral muscle. In this proceeding the scalpel should be carried in the direction of the fibres, viz. from the arm to the thorax, and the dissection may be begun either at the upper or lower border of the muscle, according to the side of the body. Afterwards the fascia and the fat are to be taken from the arm-pit, but the numerous vessels, nerves, and glands contained in the space are to be left uninjured. The task is best begun at the outer part by removing the fascia from the large axillary vessels where they are about to quit the space and enter the arm: following these upwards the student will arrive at the branches that are directed towards the chest, viz. the long thoracic under cover of the anterior boundary, and the circumflex and subscapular vessels and nerves on the posterior boundary of the axilla. Some arterial twigs enter the axillary glands, and a few should be traced out. In taking away the fascia of the posterior boundary to follow the muscles to their insertion into the humerus, a small nerve (internal cutaneous of the musculo-spiral) should be looked for towards the great vessels.

Dissec- of pectoral muscle

and the arm pit.

The AXILLA, or arm-pit, is the hollow between the arm and the chest, and is limited in front and behind by a fold containing muscles. This space is somewhat conical in form, having the apex upwards at the root of the neck, and it is larger near the thorax than at the arm. Its boundaries and contents are as follows: —

Situation and form of the arm-pit.

The two pectoral muscles form the anterior boundary, but they take unequal shares in the construction of this part in consequence of the difference in their shape and size. For whilst the pectoralis major extends over the whole front of the space, reaching from the clavicle to the lower edge of

The pectoral muscles bound it in front.

the anterior fold, the pectoralis minor, which is but a narrow muscle, corresponds only to the middle part or third of that fold. In the posterior boundary are the latissimus dorsi and teres major muscles, forming the lower edge of the fold; and higher up is the subscapularis muscle: this boundary reaches lower than the anterior, especially near the humerus, and the muscles constituting the lower margin project beyond the level of the subscapularis.

and latissimus teres and subscapularis behind.

Parts at the inner and outer sides.

On the inner side of the arm-pit are the first four ribs, with their corresponding intercostal muscles, and the part of the serratus magnus that takes origin from them. On the outer side the space has but small dimensions, and is limited by the humerus, and by the biceps and coraco-brachialis muscles.

Situation of the apex

and base.

When the fore-finger is introduced into the space the apex of the hollow will be perceived to be situate between the clavicle, the upper margin of the scapula, and the first rib. But the base or widest part of the conically shaped interval is turned downwards, and is closed by the thick aponeurosis that reaches from the anterior to the posterior fold.

Contents of the space.

In the arm-pit are contained the axillary vessels and the brachial plexus, with their branches; some branches of the intercostal nerves; together with lymphatic glands, and a large quantity of loose cellular tissue and fat. The position of all these with reference to the boundaries of the space is to be carefully studied.

Position and connections of the axillary vessels.

The large axillary vessels cross the space obliquely in their course between the trunk and the upper limb. The part of these vessels now exposed projects beyond the line of the anterior fold of the arm-pit, and is covered only by the common superficial layers, viz. the skin, the fatty or superficial fascia, and the deep fascia. Behind the vessels are the tendons of the latissimus and teres muscles. On looking into the arm-pit from below the axillary vein is seen to lie to the thoracic side of the artery, and to conceal it. After the vein is drawn aside, the arterial trunk will be found to lie amongst the large nerves of the upper limb, having the median nerve to the outside; the ulnar, the

internal cutaneous, and the small nerve of Wrisberg to the inner side; and the musculo-spiral nerve behind it. This part of the artery gives branches to the side of the chest and to the shoulder. The vein, likewise, receives some branches in this spot.

Situation of branches of vessels and nerves on the boundaries of the arm-pit.

The several branches of vessels and nerves that are contained in the space have the undermentioned position with respect to the boundaries. Close to the anterior fold, and rather concealed by it, the long thoracic artery extends to the side of the chest; and nearer the middle of the arm-pit is a small companion vein (external mammary). Extending along the posterior fold, within its lower margin, and in contact with the edge of the subscapularis muscle, are the subscapular vessels and nerves; and near the humeral end of the subscapularis the posterior circumflex vessels and nerve will be found bending backwards beneath the large axillary trunks. On the inner boundary, near the upper part, are a few inconsiderable branches of the superior thoracic artery, which ramify on the serratus muscle; but so unimportant are they that this part of the axillary space may be considered free from vessels in respect of any surgical operation. Lying on the surface of the serratus magnus muscle is the external respiratory nerve of Bell; and perforating the inner boundary of the space are the lateral cutaneous nerves of the thorax, two or more offsets of which are directed across the axilla to the arm, and receive the name intercosto-humeral.

Lymphatic glands of the axilla.

The *lymphatic glands* occupy principally the lower part of the axilla, and are nearer the chest than the arm. Commonly they are ten or twelve in number; but in this particular, as well as in size, they vary much. By their lower ends the glands receive the lymphatic vessels of the arm, the fore part of the thorax, the mamma, and the posterior surface of the back; and the efferent ducts issuing from the upper end, unite to form a trunk that opens in the neck into the lymphatic duct of the same side, or, it may be, into the subclavian vein by a separate tube. Small vascular twigs of the branches of the axillary vessels are furnished to the glands.

end in the lymphatic duct.

Pectoralis muscle.

The PECTORALIS MAJOR is a triangularly shaped muscle, with its base at the thorax and its apex at the arm. It

Origin from chest and clavicle. *arises* internally from the sternal half of the clavicle, from the cartilages of the true ribs except the last, and from the aponeurosis of the external oblique muscle of the abdomen. From this wide origin the fibres take different directions: those from the clavicle are directed obliquely downwards, and those from the lower ribs upwards beneath the others, and all end in a tendon which is *inserted* into the outer edge of the bicipital groove of the humerus. This muscle bounds the axilla anteriorly, and is connected to its fellow by a fibrous prolongation in front of the sternum. Besides the superficial structures and the mamma, the platysma covers the pectoralis major close below the clavicle. A cellular interval, which corresponds to the depression on the surface, separates the clavicular from the sternal attachment. One border (upper) is in contact with the deltoid muscle, and with the cephalic vein and a small artery; and the lower border forms the margin of the anterior fold of the axilla.

Insertion into the humerus.

Parts covering it,

and along the borders.

Dissection of the parts beneath pectoralis. *Dissection.* — After the division of the clavicular part of the pectoralis major, seek a small branch of nerve and artery that enter its under surface. Remove with the handle of the knife the fat that now comes into view above the border of the small pectoral muscle, and a membranous sheath that contains the axillary vessels and nerves will be exposed; also the cephalic vein will be seen crossing inwards to the axillary vein. A branch of nerve (anterior thoracic) and the acromial thoracic artery perforate this tube of membrane. Follow the branches of the nerve and artery to the pectoral muscles, and afterwards cut through the remaining part of the pectoralis major about its centre, and throw inwards and outwards the pieces. Dissect out next the insertion of the tendon of the pectoralis into the humerus. The parts beneath the pectoral muscle are now seen.

Tendon of insertion of pectoralis. The tendon of insertion of the pectoralis major sends upwards one expansion over the bicipital groove to the head of the humerus, another backwards to line the groove, and a third to the fascia of the arm. At its attachment to the bone it consists of two parts, anterior and posterior; the anterior receives the clavicular and upper sternal fibres, and joins the tendon of the deltoid muscle; and the posterior gives attachment to the lower ascending fibres.

The great pectoral muscle covers the pectoralis minor, and above and below this muscle it forms alone the anterior boundary of the axilla. Between the pectoralis minor and the clavicle it conceals the subclavian muscle, the sheath containing the axillary vessels, and the branches that perforate the sheath. Below the small pectoralis it lies on the side of the chest, on the axillary vessels and nerves, and near the humerus on the biceps and coraco-brachialis muscles. Parts covered by the muscle.

The PECTORALIS MINOR resembles the preceding muscle in shape, and is extended like it from the thorax to the arm. Its *origin* is connected by means of slips with the third, fourth, and fifth ribs, external to their cartilages; and its *insertion* is attached to the upper surface of the coracoid process as far as the tip. This muscle is placed before the axillary space, and assists the pectoralis major in forming the middle part of the anterior boundary. In that position it conceals the axillary vessels and the accompanying nerves, and some small nerves (anterior thoracic). Between its upper border and the clavicle is an interval of a somewhat triangular form. The lower border projects beyond the pectoralis major close to the chest, and the long thoracic artery lies along it. The tendon of insertion is united with those of the coraco-brachialis and short head of the biceps. Pectoralis minor arises from chest; inserted into scapula. Connections with parts around.

The *costo-coracoid membrane*, or ligament, receives this name from its insertion on the one side into the rib, and on the other into the coracoid process of the scapula. Between these points of attachment it is connected to the clavicle, and covers the subclavius muscle. When traced downwards the membrane is found to descend around the axillary vessels and nerves, to which it furnishes a sheath, and to end on those trunks beneath the small pectoral muscle; but its extent is not the same on all, for internally it reaches but a very short distance on the axillary vein. This sheath (axillary) resembles in its form and office the funnel-shaped tube of membrane that surrounds the femoral vessels in the upper part of the thigh. The front of the sheath is strongest near the subclavius muscle, where it forms a strong band Costo-coracoid membrane conceals subclavius, and forms a sheath around vessels. Strongest in front.

over the axillary vessels. The anterior part of the sheath is perforated by the acromial thoracic artery and the anterior thoracic nerve.

Dissection. *Dissection.* — Make a transverse incision in the costo-coracoid membrane near the clavicle, and raise the lower part of the subclavius muscle to expose a process of the deep cervical fascia that descends beneath the muscle to join that membrane. By this proceeding the subclavius muscle will be seen to be incased by fascia. Afterwards pass the handle of the scalpel along the axillary artery, and beneath the membrane that covers it, to make apparent the sheath of the vessels. Finally, remove altogether the costo-coracoid membrane both from the subclavius muscle and the axillary vessels and nerves.

Subclavius muscle is attached to clavicle and first rib. The SUBCLAVIUS MUSCLE is thin and roundish in form, and is placed between the clavicle and the first rib. It *arises* by a tendon from the cartilage of the first rib, in front of the costo-clavicular ligament, and is *inserted* into the under surface of the clavicle for nearly the half of its length. The muscle overhangs the large vessels and nerves of the limb, and is enclosed, as before said, in a sheath of fascia.

Axillary artery is arched in the axilla. The AXILLARY ARTERY continues the subclavian vessel onwards to the upper limb, and extends from the lower border of the first rib to the lower border of the teres major muscle. In its course through the axillary space, its direction is dependant upon the position of the limb to the trunk; for when the arm lies by the side of the body the vessel is curved, its convexity being upwards, and in proportion as the limb is removed to a right angle with the chest the artery becomes straight. In the upper part of the axilla the vessel is deeply placed, but it becomes superficial as it approaches the arm. Its connections with surrounding parts are numerous, and the description of these will be facilitated by dividing the extent of the artery into three parts — one above, one beneath, and one below the small pectoral muscle.

Has following connections: — above small pectoral muscle, *a.* Above the small pectoral muscle the artery is contained in the sheath of the costo-coracoid membrane, with the axillary vein on its thoracic side, and the brachial plexus of nerves on its acromial side, but separated from it

by a cellular interval. In this part it is covered by the clavicular portion of the great pectoral muscle, and the cephalic vein crosses it. Behind it are the highest intercostal space and the first digitation of the serratus muscle, together with a small nerve (external respiratory).

b. Beneath the muscle the artery is surrounded by the large nervous cords of the plexus, which separate it from the vein (still to the inner side) and from the surrounding muscles. Superficial to the vessel is the pectoralis minor, with part of the pectoralis major; and behind it is the subscapular muscle. beneath that muscle,

c. Beyond the pectoralis minor the artery is concealed in part by the lower border of the great pectoral muscle, but thence to its termination it is covered only by the integuments and the fascia. Behind it will be found the lower part of the subscapularis muscle and the tendons of the latissimus and teres. To the outer side is the coraco-brachialis muscle. Here the artery is still in the midst of the large trunks of nerves into which the plexus is resolved. Thus to the outer side is the median nerve, with the external cutaneous for a short distance; to the inner side are the ulnar and internal cutaneous, with the nerve of Wrisberg; and behind are the musculo-spiral and circumflex nerves, the latter extending only as far as the border of the subscapular muscle. The axillary vein is still to the thoracic side of the artery. and beyond it. Position of nerves and vein to it.

The *branches* of the axillary artery are furnished to the wall of the thorax and to the shoulder. The thoracic branches are four in number; of which two (superior and acromial thoracic) arise from the artery above the pectoralis minor, one (alar thoracic) beneath the muscle, and one (long thoracic) at its lower border. Three branches are supplied to the shoulder, viz. one subscapular and two circumflex; the first springs opposite the edge of the muscle of the same name, and the others wind round the neck of the humerus. Branches are supplied to the thorax and the shoulder, viz.

1. The *superior thoracic* branch is the highest offset of the artery, and arises opposite the first intercostal space; it is a small vessel, upper thoracic.

and ramifies on the side of the chest, anastomosing with the intercostal arteries.

Acromial thoracic is large, and supplies thorax and shoulder.

2. The *acromial thoracic* branch is a short trunk on the front of the artery, which appears in the interval between the pectoral and deltoid muscles. Its branches of division are directed either inwards to supply the two pectoral muscles, or outwards to the deltoid muscle. Moreover, the inner set give a few offsets to the side of the chest, which anastomose with the intercostal and other thoracic arteries; while from the outer set, a small artery runs a short distance with the cephalic vein. One or two small twigs ascend from the trunk of the artery to the subclavius and deltoid muscles; and one branch (inferior acromial) perforates the deltoid muscle, and anastomoses on the acromion with a branch of the suprascapular artery of the neck.

Inferior acromial offset.

Alar thoracic very irregular.

3. The *alar thoracic* branch is very inconstant as a distinct artery, its place being supplied frequently by offsets of the subscapular or long thoracic branches; the artery is distributed to the glands of the axillary space.

Long thoracic.

4. The *long thoracic* branch (external mammary) is directed along the border of the pectoralis minor to the side of the chest, on which it extends to about the sixth intercostal space; it supplies the pectoral and serratus muscles, and anastomoses with the intercostal and thoracic arteries. In the female it gives branches to the mammary gland.

Subscapular has

5. The *subscapular* branch courses with a nerve of the same name along the subscapular muscle, as far as the lower angle of the scapula, where it ends in branches for the serratus magnus and the latissimus dorsi and teres muscles. Near its origin the artery sends a considerable branch round the edge of the subscapular muscle to the back of the scapula: this *dorsal* branch will be afterwards dissected. The subscapular artery is frequently combined at its origin with other branches of the axillary, or with branches of the brachial artery.

a dorsal branch.

Two circumflex.

6. The *circumflex* branches (anterior and posterior) arise near the end of the axillary artery. One turns in front of and the other behind the bone. They will be followed in the examination of the arm.

Axillary vein,

The *axillary vein* is a continuation of the basilic vein of the arm, and has the same extent and connections as the axillary artery. It lies to the thoracic side of the artery, and receives thoracic and subscapular branches. Opposite the subscapular muscle it is joined externally by a large

extent and connections.

Branches.

vein, which is formed by the venæ comites of the brachial artery; and near the clavicle the cephalic vein opens into it.

Dissection. — In order to follow out the branches of the brachial plexus cut through the pectoralis minor near its insertion into the coracoid process, and turn it towards the chest, but without injuring the thoracic nerves in contact with it. Afterwards the axillary vessels are to be cut across below the first rib, and to be drawn down with hooks; the thoracic branches of these vessels may be removed. Lastly, remove the dense fascia from the large nerves of the plexus. Dissection of brachial plexus.

The BRACHIAL PLEXUS results from the union of the anterior divisions of the first dorsal and the four lower cervical nerves; and to it is added a fasciculus of the lowest nerve in the cervical plexus. This interlacement of nerves is placed partly in the neck and partly in the axilla, and divides opposite the coracoid process into large trunks for the supply of the limb. The part of the plexus above the clavicle is described in the dissection of the head and neck (p. 68.). The part below the clavicle has the same connections with the surrounding muscles as the axillary artery, and has the following disposition: — Nerves entering brachial plexus. Its situation and connections.

At first the plexus consists of two cords, which are external to the artery; that nearest the vessel being formed by the last cervical and first dorsal nerves, and the other by the fifth, sixth, and seventh cervical nerves. But a third cord is soon produced by the union of two fasciculi (one from each of the others); so that beneath the small pectoral muscle the plexus consists of three large cords, one being to the outer side, one to the inner side, and one behind the vessel. The nerves form three cords that lie around the artery.

The *branches* of the plexus below the clavicle are furnished to the muscles of the front of the chest, to some of the muscles of the scapula, to the latissimus dorsi, and to the arm. They arise from the several cords in the following manner: — and give the several branches, viz.

The *outer cord* gives origin to one anterior thoracic branch, the musculo-cutaneous trunk, and the outer head of the median nerve. from the outer,

The *inner cord* produces a second anterior thoracic nerve, the inner head of the median, the internal cutaneous, the nerve of Wrisberg, and the ulnar nerve. inner, and

Posterior cord. The *posterior cord* furnishes the subscapular branches, and ends in the circumflex and musculo-spiral nerves.

The following are seen, viz. Only the thoracic and subscapular nerves are now exposed to their termination; the remaining nerves will be seen in the arm.

two anterior thoracic. The *anterior thoracic* branches are two in number, outer and inner, with respect to the cords of the plexus.

outer *a.* The *outer* nerve crosses inwards over the axillary artery to the under surface of the great pectoral muscle in which it ends. On the inner side of the vessel it communicates with the following branch. and inner. *b.* The *inner thoracic* branch turns upwards between the artery and vein, and after receiving the branch of junction from the other, divides into many branches that enter the under surface of the pectoralis minor. Some twigs enter the great pectoral muscle by passing either through or above the border of the pectoralis minor.

Three subscapular; 2. The *subscapular nerves* are three in number. Two enter the subscapular muscle, and are named upper and lower from their relative position; and the third is the long subscapular.

upper. *a.* The *upper* branch is small, and enters the highest part of the subscapularis muscle. lower, and *b.* The *lower subscapular* branch (nerve of the teres muscle) gives an offset to the lower part of the subscapular muscle, and ends in the teres major. long subscapular. *c.* The *long subscapular* nerve takes the course of the artery of the same name along the posterior wall of the axilla, and ends in the latissimus dorsi muscle.

Posterior thoracic. Another small nerve, *posterior thoracic* (external respiratory, Bell) is now seen on the surface of the serratus muscle. It arises above the clavicle (p. 69.), from the fifth and sixth cervical nerves, and descends behind the axillary artery to be distributed to the serratus magnus, entering that surface of the muscle which is towards the axilla.

Latissimus in the fold of the axilla. The LATISSIMUS DORSI MUSCLE can now be observed as it forms part of the posterior fold of the axilla. Arising from the trunk of the body, and crossing the lower angle of the scapula, the muscle ascends to be *inserted* by a tendon into the bottom of the bicipital groove. Disposition of its fibres. The fibres have a cross arrangement in their course to the tendon of insertion; for whilst those that are attached to the lower ribs ascend to

the upper edge of the tendon, those from the spines of the dorsal vertebræ descend to its lower edge. Thus the fibres produce a hollow or groove, which lodges the lower border of the scapula and the teres major muscle.

Dissection. — Cut across the nerves of the brachial plexus below the first rib, and draw the arm from the trunk so as to separate the scapula from the thorax. The serratus muscle, which is now seen to pass from the chest to the base of the scapula, will be exposed by the removal of cellular structure. Dissection of the serratus.

The SERRATUS MAGNUS MUSCLE extends between the base of the scapula and the thorax. It *arises* by eight or nine pointed digitations from as many of the upper ribs; and it is *inserted* into the angles and the base of the scapula. From the difference in the direction of its fibres, the muscle appears to consist of three parts. The *upper* part is attached on the one side to the first two ribs and to an aponeurotic arch between them; and on the other side to an impression on the ventral surface of the upper angle of the scapula. A *middle* part, which is very thin, extends from the second, third, and fourth ribs to the base of the shoulder bone. And a *lower* part, which is the strongest, is connected internally with four ribs (fifth, sixth, seventh, and eighth), digitating with processes of origin of the external oblique muscle; and externally it is fixed into the rough surface of bone on the costal aspect of the lower angle of the scapula. The muscle is applied against the ribs and the intercostal muscles, and is partly concealed by the pectoral muscles and the axillary vessels and nerves: in the ordinary position of the arm, the scapula and the subscapularis muscle are in contact with it. Serratus muscle is attached to the ribs and scapula. And its fibres seem to form three parts. Connections of the muscle.

Dissection. — Detach the processes of origin of the serratus from the ribs, and preserve some of the lateral cutaneous nerves of the thorax. Take the cellular membrane from the external layer of the intercostal muscles, and define a thin aponeurosis that is continued forwards from it to the sternum. Dissec. of the intercostal muscles.

The INTERCOSTAL MUSCLES are named from their position between the ribs. Their number and their extent are determined by the intercostal spaces; and they consist of two layers in each space, whose fibres cross. Those of the ex- Intercostal muscles are two layers in each space.

ternal muscle pass downwards and forwards, and those of the internal layer have an opposite direction.

Outer layer

The *external muscle* is fixed to the outer margins of the ribs of the corresponding space, and consists of fleshy and tendinous fibres. Posteriorly the fibres are continuous in direction with those of the levatores costarum muscles; and anteriorly they cease near the cartilages of the ribs, but a thin aponeurosis continues the muscle onwards to the sternum. In the lower spaces, the external muscle is continuous in front with the fibres of the external oblique muscle of the abdomen.

is deficient anteriorly; joins external oblique below.

Dissection.

Dissection. — Cut through the external layer in one of the spaces, say the second, where it is widest, and take it away to bring into view the internal intercostal muscle, which will be recognised by the difference in the direction of the fibres. Far back between the two, and close to the rib above, the intercostal nerve and artery will be found. A branch of the nerve to the surface (lateral cutaneous of the thorax) should be followed through the external layer of muscle, and the trunk of the nerve should be traced forward in one or more spaces to the sternum and the surface of the thorax.

Inner layer of the muscles deficient posteriorly;

The *internal intercostal* muscle is attached to the inner border of the ribs bounding the intercostal space. It begins at the sternum, and ceases near the angle of the ribs. One surface is covered by the external muscle and by the intercostal vessels and nerve; and the opposite surface is in contact with the pleura. In the lower spaces, corresponding to the false ribs, the fibres of the inner layer are continuous with those of the internal oblique muscle of the abdomen. The intercostal muscles are exposed in part, both in the dissection of the back and in that of the thorax.

joins internal oblique below.

Dissection of internal mammary vessels.

Dissection. — To bring into view the triangularis sterni muscle and the internal mammary vessels, take away on the right side of the body the greater part of the cartilage of each true rib, except the first and seventh, but leave these untouched for the advantage of the dissection of the abdomen and of the head and neck. Small branches of arteries to each intercostal space and to the surface of the thorax, as well as the intercostal nerves, are to be preserved. The surface of the triangularis sterni will be made apparent by removing the cellular membrane from it.

The TRIANGULARIS STERNI is a thin muscle which is placed inside the cavity of the thorax. It *arises* from the side of the xyphoid cartilage and the side of the sternum; and its fibres are directed outwards, the upper being most oblique, to be *inserted* into the cartilages of the true ribs, except the last two and the first, and into aponeurotic bands in the intervals between the ribs. The muscle is covered by the ribs and the internal intercostal muscles, and by the internal mammary vessels and the intercostal nerves. It lies on the pleura; its lower fibres are contiguous to those of the transversalis abdominis.

Triangularis sterni is in the thorax and attached to the ribs.

Connections.

The *internal mammary artery* is a branch of the subclavian, and enters the thorax beneath the cartilage of the first rib. It is continued through the thorax beneath the cartilages of the ribs, lying about half an inch from the sternum, as far as the interval between the sixth and seventh; here it gives externally a large muscular branch (musculo-phrenic), and then passing beneath the seventh rib, enters the sheath of the rectus muscle of the wall of the abdomen. In this course in the chest the artery lies on the pleura and the triangularis sterni, and it is crossed by the intercostal nerves. It is accompanied by two veins and by a chain of lymphatic glands. The following *branches* take origin in the thorax: —

Internal mammary is a branch of subclavian; courses through thorax to abdomen.

Branches

1. A small branch (*comes nervi phrenici*) arises as soon as the artery enters the chest, and descends to the diaphragm along the phrenic nerve.

of phrenic nerve,

2. A few small *mediastinal* branches are distributed to the remains of the thymus gland, the pericardium, and the triangularis sterni muscle.

mediastinal,

3. Two *anterior intercostal branches* turn outwards in each space, one being placed on the border of each costal cartilage, and terminate by anastomosing with the aortic intercostal arteries.

intercostal, and

4. *Perforating branches*, one or two for each space, pierce the internal intercostal and pectoral muscles, and are distributed on the surface with the intercostal nerves. The lower branches supply the mamma of the female.

perforating branches.

5. The *musculo-phrenic* branch courses outwards beneath the cartilages of the seventh and eighth ribs, and enters the wall of the abdomen by perforating the diaphragm. It supplies anterior branches to the lower intercostal spaces, and its termination will be seen in the dissection of the abdominal wall.

Musculo-phrenic branch.

Two *veins* accompany the artery, but they join into one

Veins.

trunk, which opens into the superior vena cava; whilst on the left side they join the left brachio-cephalic vein.

Intercostal nerves; The *intercostal nerves* are seen only in the anterior part of their extent. They are the anterior trunks of the dorsal nerves, and are placed between the layers of the intercostal course, muscles. About midway between the spine and the sternum, each gives off the lateral cutaneous nerve of the thorax. Diminished in size, the trunk is continued onwards, at first in, and afterwards beneath the internal intercostal muscle, as termination, and far as the side of the sternum, where it ends as the anterior branches. cutaneous nerve of the thorax. The intercostal nerves supply branches to the intercostal muscles, and to the triangularis sterni.

Intercostal arteries are with the nerves, and branch into two. The *aortic intercostal arteries*, whilst in the wall of the thorax, lie with the nerves between the strata of intercostal muscles, and nearer the upper than the lower rib of the contained space. About the mid point of the intercostal space the artery bifurcates: one branch follows the line of the upper rib, and the other descends to the lower rib: both anastomose anteriorly with the intercostal branches of the internal mammary artery. A small cutaneous offset accompanies the lateral cutaneous nerve of the thorax.

At this stage the thorax and back are dissected. The dissector of the upper limb now waits the appointed time for the examination of the thorax. Afterwards the body is to be turned for the dissection of the back, and the student is to proceed with the parts marked for him in that chapter. When the back is finished, the student is to detach the limb from the trunk by sawing the clavicle about the middle, and cutting through the soft parts connected with the scapula.

SECTION II.

SCAPULAR MUSCLES, VESSELS, NERVES, AND LIGAMENTS.

Dissection of muscles. *Dissection.*—WHEN the limb is separated from the trunk it is to be placed with the subscapularis uppermost, and the different muscles that have been dissected are to be traced to their insertion into the scapula, a small part of each (about an inch) being left.

The borders and the angles of the scapula have the following muscles attached to them: — Muscles inserted

The *upper margin* of the scapula has one muscle, the omo-hyoid, attached to it. At its origin that muscle is about half an inch wide, and is connected to the edge of the bone behind the notch, but sometimes to the ligament (posterior proper) which converts the notch into a foramen. The *lower margin*, or costa, gives origin to the long head of the triceps, and to some fibres of the teres major; but these statements will be verified in the progress of the dissection. into the margins of the scapula;

The *base* of the bone has many muscles inserted into it. Between the superior angle and the spine, the levator anguli scapulæ is inserted. The rhomboideus minor is fixed to a part of the bone opposite the spine, and the rhomboideus major is inserted between the spine and the inferior angle: the upper fibres of the last muscle often end in an aponeurotic arch, which is connected to the bone by an expansion. Internal to these muscles, and inserted into the whole extent of the base of the scapula, is the serratus magnus muscle. into the base;

On the *angles* of the scapula the fibres of the serratus magnus are collected in this way: the highest fibres are fixed to the under surface of the upper angle, and the lower fibres are inserted into an impression on that aspect of the lower angle. On the outer surface of the inferior angle is the teres major, which will be subsequently seen. The insertion of the small pectoral muscle into the coracoid process may likewise be now examined. into the angles of the bone.

Dissection. — After the serratus is separated from the subscapularis, let the student observe a thin fascia that belongs to the last muscle, and is fixed to the bone around its margins. Remove this fascia and follow forwards the muscle to its insertion into the humerus. Clean next the axillary vessels and nerves. Dissection.

The SUBSCAPULARIS MUSCLE, as the name expresses, is concealed by the scapula, when the limb is in its natural position. The muscle *arises* from all the concave surface of the ventral aspect of the scapula, being connected to the ridges of the bone by tendinous processes; and is *inserted* by a tendon into the small tuberosity of the humerus, and Subscapularis fills the hollow of scapula; is inserted into

humerus. by fleshy fibres into the neck of the bone below that process.

Connections. By one surface the muscle bounds the axilla, and is in contact with the axillary vessels and nerves, and the serratus magnus. By the other, it rests against the scapula and the shoulder joint. The lower border projects much beyond the bone, and comes into contact with the latissimus dorsi and the long head of the triceps: here it is contiguous to the teres major. Along this border is the subscapular artery giving backwards its dorsal branch.

Dissection. *Dissection.* — Separate the subscapular muscle from the bone, noticing the tendinous processes of origin, and observing that the tendon of insertion is inseparably united with the capsule of the shoulder joint. Between the tendon and the root of the coracoid process is a bursa, which communicates with the shoulder joint. A small arterial anastomosis on the ventral surface of the bone is likewise to be dissected out.

Small infrascapular artery. The *infrascapular artery*, ramifying on the ventral surface of the scapula, is an offset of the dorsal branch of the subscapular artery. It enters beneath the subscapular muscle, and forms an anastomosis with small twigs of the supra- and posterior scapular branches.

Dissection of the shoulder. *Dissection.* — Turn over the scapula, and place a block between it and the arm, which is of sufficient height to allow the shoulder to be made prominent. Remove the skin from the prominence of the shoulder, beginning in front, and seek some small cutaneous nerves that lie in the fat. Some of these descend from above, and others come to the surface about half way down the posterior border of the deltoid muscle.

Cutaneous nerves of the shoulder. Branches of nerves, *supra-acromial*, descend to the surface of the shoulder from the cervical plexus. A *cutaneous branch* of the circumflex nerve turns forward from beneath the posterior border of the deltoid, and supplies the integument covering the lower two thirds of that muscle.

Dissection of deltoid muscle. *Dissection.* — Take the fascia from the deltoid muscle, its fibres being made tense at the time. Beginning at the anterior edge of the muscle, the dissector is to carry the knife upwards and downwards in the direction of the fibres, in order to clean more easily the coarse, rough, muscular fasciculi. At the same time the fascia may be removed from the back of the scapula, so as to expose the teres major and a part of the infraspinatus muscle.

Deltoid muscle. The DELTOID MUSCLE is triangular in form, and has its

base at the scapula and the clavicle, and its apex at the humerus. It *arises* from all the lower edge of the spine of the scapula, from the acromion, and from the outer half or third of the clavicle. Its fibres converge to a tendon, which is *inserted* into an impression on the outer surface of the humerus, about the middle. The anterior border is contiguous to the pectoralis major muscle and the cephalic vein; and the posterior rests on the infraspinatus and triceps muscles. The origin of the muscle corresponds to the extent of the attachment of the trapezius to the same bones, and the insertion has a fasciculus of the brachialis anticus on each side of it.

Origin.

Insertion.

Adjacent parts.

Dissection. — Cut across the deltoid near its origin, and throw it down as much as the circumflex vessels and nerve will permit. Take the cellular membrane from the vessels and the nerve; also remove the remains of a bursa between the muscle and the head of the humerus. The tendon of insertion may be seen to be united with that of the pectoralis major.

Dissection to detach deltoid.

The deltoid conceals the head and the upper part of the humerus, and the parts of the teres minor, infraspinatus, and supraspinatus muscles that are fixed to the great tuberosity of that bone. Below the head of the bone are the circumflex vessels and nerve, and the upper part of the biceps muscle; and in front of the humerus is the coracoid process with its muscles. A large bursa intervenes between the convex head of the bone and the under surface of the deltoid muscle.

Parts covered by the deltoid.

Dissection. — Follow back the circumflex vessels and nerve, through a space between the humerus and the long head of the triceps, to their origin from the axillary trunks. In taking the fat from this space be careful of a branch of nerve to the teres minor muscle. Arching backwards, in front of the neck of the humerus, is the small anterior circumflex artery.

Dissection of circumflex vessels.

The *circumflex arteries* are the last branches of the axillary trunk, and arise near its termination. They are two in number, and are named anterior and posterior from their position on the neck of the humerus.

Two circumflex arteries:

a. The *anterior* branch is a small artery that courses transversely outwards beneath the coraco-brachialis and biceps muscles, and

anterior and

anastomoses in front of the humerus with branches of the posterior circumflex. As it crosses the bicipital groove it gives off a branch which ascends in that hollow to the articulation and the head of the humerus.

poste-rior. *b*. The *posterior circumflex* artery is larger in size, and arises opposite the border of the subscapular muscle. It winds backwards through a space between the humerus and the long head of the triceps, and is chiefly distributed to the deltoid muscle, in which it anastomoses with the acromial thoracic artery. Branches are given from it to the head of the humerus and the shoulder joint, and others anastomose with the anterior circumflex artery. It supplies branches likewise to the teres minor and the long head of the triceps.

One circumflex nerve The *circumflex nerve*, at its origin (p. 227.), is placed beneath the axillary artery, and leaves the axilla by turning round the border of the subscapular muscle, with the artery of the same name. Behind the neck of the humerus the nerve divides into two parts that supply the surrounding muscles, the integuments, and the shoulder joint: —

has cutaneous, muscular, and One branch of division turns forwards beneath the deltoid muscle nearly to the front, and ends in the muscle, with the exception of one or two cutaneous filaments that pierce the fibres. The other gives a branch to the teres minor muscle, which is remarkable in having a gangliform swelling on it; and this division, after supplying the posterior part of the deltoid becomes cutaneous over articular branches. the muscle (p. 234.). Before the circumflex nerve bifurcates it gives an *articular* filament to the under part of the shoulder joint.

Infraspinatus muscle The INFRASPINATUS MUSCLE occupies the infraspinal fossa of the scapula, and extends to the head of the humerus. arises from fossa of that name; The muscle *arises* from all the infraspinal fossa of the scapula, except at the neck of the bone; from the lower side of the spine of that bone, and from the fascia that covers the surface. Its fibres converge to a tendon, which is Insertion. *inserted* into the middle impression on the great tuberosity of the humerus, joining with the tendons of the supraspinatus and teres minor muscles. is partly covered by deltoid. The greater part of the muscle is subcutaneous, and the fibres that arise from the spine of the scapula overlay the others: the upper part is concealed by the deltoid, and the lower end, by the latissimus dorsi. Other The lower border is parallel to the teres minor, with

which it is sometimes united. The muscle lies on the scapula and the humero-scapular articulation. Connections.

Teres minor is on back of the scapula. The TERES MINOR is a narrow fleshy slip which is often inseparably united with the preceding muscle, along whose lower border it lies. It *arises* on the dorsum of the scapula, from a surface between the inferior costa and the part of the bone that gives origin to the infraspinatus muscle; and it is *inserted* by a tendon into the lowest of the three marks on the great tuberosity of the humerus, and by fleshy fibres into the humerus below that spot. Insertion with the former. This muscle is partly covered by the deltoid; and it rests on the long head of the triceps and the shoulder joint. Underneath it the dorsal branch of the subscapular artery turns. Parts around it.

Teres major reaches from lower angle of scapula to the humerus. The TERES MAJOR muscle is extended from the inferior angle of the scapula to the humerus. Its *origin* is from the rough surface on the dorsum of the scapula near the inferior angle, and from the inferior costa of the bone for some distance. The fibres end in a tendon which is *inserted* into the inner edge of the bicipital groove of the humerus. This muscle forms part of the posterior fold of the axilla, and has the axillary vessels and nerves on it near the humerus. At its origin it is covered by the latissimus dorsi. Adjacent muscles. The upper border is contiguous to the subscapularis muscle, and the lower is received into a hollow formed by the fibres of the latissimus dorsi. Near the humerus the tendon of the muscle lies behind that of the latissimus, and the two are separated by a bursa: an expansion is sent from these tendons to the fascia of the arm.

Two spaces between the teres and head of the triceps. Below the scapula (inferior costa) where the teres muscles separate from one another, is a triangular interval, which is bounded in front by the shaft of the humerus, and above and below by the teres muscles. This space is divided into two by the long head of the triceps. Anterior and posterior. Through the anterior part, which is of a quadrilateral shape, the posterior circumflex artery and the circumflex nerve pass to the outer side of the limb; and through the posterior smaller part, the dorsal branch of the subscapular artery turns to its distribution.

Dissection of ligaments of the clavicle

Dissection. — Examine next the special ligaments of the scapula and those uniting the clavicle with the scapula, in order that the acromion process may be sawn through to expose the supraspinatus muscle. These ligaments will be recognised by removing the cellular membrane in the spots now specified. One ligament (coraco-clavicular) passes from the coracoid process to the under part of the clavicle. A capsular ligament, connecting the outer end of the clavicle with the acromion, will be seen by taking away the fibres of the trapezius and deltoid muscles. Another strong band (coraco-acromial) passes transversely between the acromion and the coracoid process; and lastly a small fasciculus (posterior proper ligament) will be found over the notch in the superior costa.

and scapula.

Union of the clavicle and scapula.

LIGAMENTS OF THE CLAVICLE AND SCAPULA. — The clavicle is connected to the scapula by a distinct articulation with the acromion, and by a strong ligament (coraco-clavicular) between it and the coracoid process.

Coraco-clavicular, has a conical

The *coraco-clavicular* ligament consists of two parts, each having a different direction and designation. The posterior part, called *conoid* from its shape, is fixed by its apex to the posterior part of the coracoid process, and by its base to the tubercle on the under surface of the clavicle. The anterior part, *trapezoid ligament*, is external to the conoid piece: it is connected inferiorly to the inner border of the coracoid process, and superiorly to the line on the under surface of the clavicle, extending towards the outer end of the bone. The two parts of the ligament are united posteriorly, but are separated by an interval in front.

and a square piece.

Joint with the acromion,

Acromio-clavicular articulation. — The articular surfaces of the clavicle and acromion process of the scapula, are retained in contact by some scattered fibres, which form a kind of capsule for the joint. Some of the fibres are thicker above and below, constituting a *superior* and an *inferior* ligament. An *inter-articular fibro-cartilage* is generally found between the bones at the upper part of the joint; but sometimes it forms a complete interarticular septum. If the fibro-cartilage is perfect, there are two *synovial membranes*: if it is imperfect, there is only one present in the joint. The joint should be opened to see the cartilage and the synovial membrane.

superior and inferior bands, fibro-cartilage,

and synovial sac.

The SPECIAL LIGAMENTS of the scapula are two in number, anterior and posterior, and extend from one part to another of the bone. Ligaments of scapula.

a. The *posterior* ligament is a round fasciculus of fibres across the notch in the upper costa of the scapula. By one end it is attached to the base of the coracoid process, and by the other to the costa behind the notch. It converts the notch into a foramen, through which the suprascapular nerve passes. Posterior and

b. The *anterior* ligament extends transversely between the acromion and the coracoid process. Externally it is inserted by a pointed process into the front of the acromion; and internally it widens, and is attached to the outer border of the coracoid process. This ligament overhangs the shoulder joint; it usually consists of two thick bands, anterior and posterior, with a thin intervening part. anterior. This is formed of two pieces.

Dissection.—Saw through the acromion process, and remove it with the outer end of the clavicle. The supraspinatus muscle will come into view on the removal of a strong fascia that covers it. Dissection.

The SUPRASPINATUS MUSCLE has the same form as the hollow of the bone that it fills. It *arises* from all the surface of bone in the supraspinal fossa of the scapula, except near the neck; from the upper side of the spine of that bone, and from the fascia covering the surface. Its fibres end in a tendon that crosses over the shoulder joint, and is *inserted* into the upper impression on the great tuberosity of the humerus. The muscle is concealed by the trapezius and the acromion process; and it rests upon the scapula, the shoulder joint, and the suprascapular vessels and nerve. An expansion from the tendon joins the insertion of the infraspinatus. Supraspinatus fills the hollow of that name; is inserted into humerus. Connections.

Dissection.—Separate the supra and infraspinatus muscles from the bone to trace the vessels and nerves. In the supraspinal fossa will be seen the suprascapular vessels and nerve, which are to be followed beneath the acromion to the infraspinal fossa. Entering the infraspinal fossa, beneath the teres minor muscle, is the dorsal branch of the subscapular artery. The anastomosis between the vessels is to be cleaned. Dissection of suprascapular vessels.

Supra-scapular artery

The *suprascapular artery* is derived from the subclavian trunk, and is one of the branches into which the thyroid axis subdivides (p. 66.). After a course in the neck it crosses over the ligament of the superior costa, and enters beneath the supraspinatus muscle. It now furnishes a *supraspinal* branch for the supply of that muscle, the bone, and the shoulder joint; and it ends in the infraspinal fossa, where it furnishes offsets to the infraspinatus muscle and the scapula, and anastomoses with the posterior scapular and the dorsal branch of the subscapular artery.

gives a supra-spinal branch, and ends in infra-spinatus.

Vein.

The companion *vein* of the suprascapular artery joins the external jugular vein.

Supra-scapular nerve has muscular branches like artery,

The *suprascapular nerve* is a branch of the brachial plexus (p. 69.). When it reaches the costa of the scapula, it enters the supraspinal fossa beneath the posterior proper ligament. In that fossa it supplies two branches to the supraspinatus; and the nerve is then continued, beneath a fibrous band, to the infraspinatus muscle, in which it ends. The nerve gives some *articular* filaments to the shoulder joint, and other offsets to the scapula.

and articular.

Dorsal branch of sub-scapular artery.

The *dorsal branch* of the *subscapular artery* turns backwards below the inferior costa of the scapula, through the posterior of the two spaces between the teres muscles. Entering the infraspinal fossa, beneath the teres minor, it supplies that muscle and the infra-spinatus, and anastomoses with the ending of the suprascapular artery. This artery sends a branch on the dorsum of the scapula, between the teres muscles, towards the inferior angle of that bone, where it anastomoses with the posterior scapular artery.

Section III.

THE ARM.

Position, and incisions in the skin.

Dissection.—For the dissection of the anterior part of the arm let the limb lie flat with the front uppermost. Make then an incision in the skin, along the centre of the biceps, as far as two inches below the elbow joint. At the termination of this first cut make a second, half round the fore-arm, and raise the skin from the front and back of the arm. The fat or the superficial fascia, which contains the cutaneous vessels and nerves, comes into view on the removal of the skin. Between the skin and the prominence of the olecranon is a large bursa.

Seek superficial veins.

Seek now the cutaneous veins in the fat. These vessels are very numerous below the bend of the elbow, and issue from beneath the integument. In the centre of the fore-arm is the median vein, which bifurcates rather below the elbow. Exter-

nal to this is a small vein (radial); and internal to it are the anterior and posterior ulnar veins coming from the front and back of the fore-arm. In the arm these veins are united into two; one (basilic) is to be followed along the inner border of the biceps, and the other (cephalic) along the outer side of the muscle.

Next expose and trace onwards the cutaneous nerves. On the outer side of the arm, about its middle, are the external cutaneous branches (two in number) of the musculo-spiral; and in the outer bicipital groove, in front of the elbow or rather below it, is the cutaneous part of the musculo-cutaneous nerve. On the inner part of the limb the nerves of the surface are more numerous. Taking the basilic vein as a guide, the internal cutaneous nerve of the fore-arm will be found by its side, about the middle of the arm; and rather external to this nerve is a small cutaneous offset from it, which pierces the fascia higher up. Behind the internal cutaneous, in the lower third of the arm, is the small nerve of Wrisberg; and in the upper third are the small nerves that have been already exposed in the dissection of the axilla, viz. the intercosto-humeral and internal cutaneous of the musculo-spiral. Trace cutaneous nerves of outer side and inner side of the limb.

The *superficial fascia* is thicker in front of the elbow than in the other parts of the arm. Here it may be divided into two layers, which enclose the superficial vessels and lymphatics. Superficial fat.

CUTANEOUS VEINS. — The position and the connections of the several superficial veins in front of the elbow are to be attentively noted by the dissector, because the operation of venesection is commonly practised on one of them. The cutaneous veins are

The *median* vein of the fore-arm divides into two branches (internal and external), rather below the bend of the elbow, and at its point of division it is joined by a branch from a deep vein. The internal branch (median basilic) crosses to the inner border of the biceps, and unites with the ulnar veins to form the basilic vein of the inner side of the arm. The external branch (median cephalic) is usually longer than the other, and by its union with the radial vein gives rise to the cephalic vein. median vein; its two branches of division.

The *basilic* vein, commencing near the inner condyle of the humerus in the manner before said, ascends near the inner border of the biceps muscle to the middle of the arm, where it passes beneath the deep fascia, and becomes the Basilic vein on inner side of the arm.

axillary vein. In this course it lies over, or to the inner side of the brachial artery.

Cephalic vein at outer side of the arm. The *cephalic vein* is chiefly derived from the external branch of the median, for the radial vein is oftentimes very small. It is continued to the shoulder along the outer side of the biceps, and sinks between the deltoid and pectoral muscles to open into the axillary vein, near the clavicle.

Position and connections of median cephalic, *Branches of the median vein.* — The *median cephalic* vein is directed obliquely outwards, and lies over the hollow between the biceps, and the outer mass of muscles of the forearm. Beneath it is the musculo-cutaneous nerve. This vein is altogether removed from the brachial artery, and is generally smaller than the median basilic vein. If opened with a lancet, it does not yield much blood in consequence of its sinking between the muscles, and the inability to compress it. The *median basilic* vein is usually more horizontal in direction than the preceding, and crosses the brachial artery in its course to the inner side of the arm. It is larger than the corresponding vein of the outer side of the arm, and is firmly supported by the fascia beneath. Branches of the internal cutaneous nerve lie beneath it, and some small twigs of the same nerve are generally placed over it. Only the aponeurosis of the arm, strengthened by fibres from the tendon of the biceps, intervenes between the vein and the brachial vessels. The median basilic is the vein commonly selected for the operation of bloodletting, by reason of its size and superficial position, and the facility with which it may be compressed. But from the close proximity of the vein to the brachial vessels, the spot chosen for venesection should not be immediately over the line of the artery.

and of the median basilic vein.

Venesection is practised in this branch.

Superficial lymphatics. The *superficial lymphatics* of the arm lie for the most part along the basilic vein, and open into the glands of the axilla. A few lymphatics accompany also the cephalic vein, and passing between the pectoral and deltoid muscles, end as the others in the axillary glands. A lymphatic gland is commonly found as low as the elbow, where it lies in front of the inner condyle of the humerus.

The superficial nerves CUTANEOUS NERVES. — The superficial nerves of the arm appear on the inner and outer sides, and spread therefrom

to cover the circumference of the limb. All with one exception (intercosto-humeral) are derived from the brachial plexus, either as distinct branches, or as offsets of other branches. On the outer side of the limb are branches of the musculo-spiral and musculo-cutaneous nerves; and on the inner side are two internal cutaneous nerves (large and small), a third from the musculo-spiral, together with the intercosto-humeral nerve. are derived from brachial plexus, except one.

EXTERNAL CUTANEOUS NERVES. — The external cutaneous branches of the *musculo-spiral* nerve are two in number. The *upper* one turns forwards with the cephalic vein, and reaches to the front of the elbow, supplying the anterior part of the arm. The *lower* pierces the fascia somewhat lower down, viz. about the middle of the outer surface of the arm, and after supplying some cutaneous filaments to that part of the limb, is continued to the fore-arm. Two external cutaneous of musculo-spiral.

The cutaneous part of the *musculo-cutaneous nerve* pierces the fascia in front of the elbow, and at the outer side of the tendon of the biceps muscle. It lies beneath the median cephalic vein, and divides into branches for the fore-arm. and one of musculo-cutaneous.

INTERNAL CUTANEOUS NERVES. — The *larger internal cutaneous nerve* perforates the fascia in two parts, or as one trunk that divides almost directly into two. The external division lies beneath the median basilic vein, and is directed to the front of the fore-arm; but the internal branch winds to the back of the fore-arm, over the prominence of the inner condyle of the humerus. Two internal cutaneous of brachial plexus. Large

A *cutaneous* offset of this nerve pierces the fascia near the axilla, and reaches as far, or nearly as far as the elbow: it supplies the integuments over the inner part of the biceps muscle.

The *small internal cutaneous* nerve (Wrisberg) appears below the preceding, and extends to the interval between the olecranon and the inner condyle of the humerus, where it ends in filaments over the back of the olecranon. The nerve gives offsets to the posterior surface of the lower third of the arm, and joins above the elbow the inner division of the larger internal cutaneous nerve. and small.

The *internal cutaneous branch* of the musculo-spiral nerve, after it becomes subcutaneous (in the upper third), winds to the back of the arm, and extends nearly as far as the olecranon. Cutaneous of musculo-spiral.

The *intercosto-humeral* branch of the second intercostal nerve (p. 217.) perforates the fascia near the axilla, and furnishes filaments to the inner side and posterior surface of the arm, in the upper half. But the size, and even the distribution of the nerve, Intercosto-humeral.

will depend upon the extent and development of the small internal cutaneous and the offset of the musculo-spiral nerve.

Deep fascia of the arm

The *aponeurosis* of the arm is a white shining membrane that envelops the limb, and sends inwards processes between the muscles. Over the biceps muscle it is thinner than elsewhere. At certain points it receives accessory fibres from the subjacent tendons: thus in front of the elbow is an offset from the tendon of the biceps, and near the axilla the tendons of the pectoralis major, latissimus dorsi, and teres, send prolongations to the fascia. At the upper part of the limb the fascia is continuous with that of the axilla, and is prolonged over the deltoid and pectoral muscles to the scapula and the clavicle. Inferiorly it is continued to the fore-arm, and is connected to the prominences of bone around the elbow joint, especially to the condyloid ridges of the humerus. Its attachments to those lines of the humerus give rise to the two intermuscular septa of the arm.

forms inter-muscular septa.

Dissection of the muscles.

Dissection. — Replace the skin on the back of the arm until the front is dissected. The limb is to be raised by means of a small block beneath the scapula, and its inner surface is to be placed towards the dissector. Tie then the vessels and nerves to the coracoid process, and fix the scapula in such a position as to render tense the muscles. Make an incision through the aponeurosis, along the centre of the arm, and remove it on the outer side as far as the line of the humerus leading to the outer condyle, but on the inner side rather farther back than the corresponding line, so as to expose part of the triceps muscle. Carry the knife in the direction of the fibres of the biceps muscle, and be careful not to displace the brachial artery and the nerves that are with it.

Position of the muscles of the arm.

Muscles on the front of the arm. — The most prominent muscle along the centre of the arm is the biceps; and lying to its inner side, for about half way down, is the coraco-brachialis muscle. The brachialis anticus muscle is beneath the biceps. Some muscles of the fore-arm are connected to the outer and inner condyles of the humerus, as well as to the line above the outer condyle.

Biceps has a short and long head.

The BICEPS MUSCLE forms the prominence observable on the front of the arm. It is wider at the middle than at either end, and the upper part of the muscle consists of two

pieces or heads of different lengths. The short head *arises* from the apex of the coracoid process in common with the coraco-brachialis muscle; and the long head, which is tendinous, is attached to the upper part of the glenoid cavity of the scapula. About the middle of the arm, these two parts become blended in one fleshy mass, which is somewhat flattened, and is *inserted* by a tendon into the radius behind the tubercle. The muscle is superficial except at the extremities. At its upper part the biceps is concealed by the pectoralis major and deltoid muscles, and at the lower part the tendon dips into the hollow in front of the elbow, after having given an offset to the fascia of the arm. Beneath the biceps are the brachialis anticus muscle, the musculo-cutaneous nerve, and the upper part of the humerus. The inner border is the guide to the brachial artery, below the middle of the humerus, but above that spot the coraco-brachialis muscle intervenes between it and the vessel. The connection of the long head of the biceps with the shoulder joint, and the insertion of the muscle into the radius will be afterwards dissected.

Origin from the scapula.

Insertion into radius.

Parts covering

and beneath it.

Inner border is guide to the artery.

The CORACO-BRACHIALIS is a muscle of a roundish form, and is named from its bony attachments. Its *origin* is fleshy from the tip of the coracoid process, and its *insertion* is connected with a rough surface on the inner side of the humerus, about opposite the attachment of the deltoid muscle on the opposite side. Part of the muscle is beneath the pectoralis major, and forms a prominence in the axilla, but the rest is superficial, except at the insertion. Perforating it is the musculo-cutaneous nerve, and on the tendon of insertion the brachial artery lies. Along the inner border is the large artery of the limb with its nerves. The coraco-brachialis conceals the subscapular muscle, the anterior circumflex artery, and the tendons of the latissimus and teres.

Coraco-brachialis is named from the attachments.

Connections of surrounding parts.

The BRACHIAL ARTERY is a continuation of the axillary trunk, and supplies vessels to the upper limb. It begins at the lower border of the teres major muscle, and ends rather below the bend of the elbow in branches (radial and ulnar) for the fore-arm.

Brachial artery extends to elbow.

In the upper part of its extent the vessel is internal to the

Position to bone,

and situation in the limb. humerus, but afterwards it is in front of that bone; and its situation is indicated on the surface by the depression along the inner border of the biceps and coraco-brachialis muscles.

Connections with muscles and fasciæ. In its course the brachial artery is superficial, and is covered only by the integuments and the deep fascia, except at the bend of the elbow, where it is crossed by the median basilic vein and the prolongation from the tendon of the biceps. To the outer side of the vessel are the coraco-brachialis and biceps muscles, the latter somewhat overlapping it in the lower part of the arm. Posteriorly, the artery is in contact with the following muscles: thus, whilst it is inside the humerus it rests on the long head of the triceps and on the inner head of the same muscle; but when the vessel is placed in front of the bone, it lies on the insertion of the coraco-brachialis and on the brachialis anticus.

with vessels *Venæ comites* lie on the sides of the artery, encircling it with branches; and the basilic vein is over the line of the artery in the lower half of the arm, but separated from it by

and with nerves. fascia. The nerves in relation with the artery are the following:—The internal cutaneous is in contact with the vessel until it has perforated the fascia about the middle of the arm. The ulnar nerve lies to the inner side as far as the insertion of the coraco-brachialis muscle; and the musculo-spiral is behind the artery for a distance of about two inches. The median nerve is close to the artery in all its course, but alters its position in this way:—as low as the insertion of the coraco-brachialis the nerve is on the outer side, but it then crosses obliquely either over or under the artery, and is placed internal to that vessel about two inches above the elbow joint.

Its branches are *Branches* spring both externally and internally from the brachial artery. Those on the outer side are muscular, and supply the coraco-brachialis and biceps; those on the inner side are named superior and inferior profunda, anastomotic, and nutritious arteries.

superior profunda 1. The *superior profunda* branch is larger than the others, and leaves the artery near the lower border of the tendon of the teres major; it winds backwards with the musculo-spiral nerve to the triceps muscle, and will be dissected with the back of the arm.

2. The *inferior profunda* branch arises opposite the coraco-brachialis muscle, and accompanies the ulnar nerve to the interval between the olecranon and the inner condyle of the humerus. In the spot mentioned it anastomoses with the posterior ulnar recurrent and anastomotic branches, and supplies the triceps. It often arises in common with the superior profunda artery. inferior profunda,

3. The *nutritious* artery is given off near the preceding branch, and enters the nutrient canal about the middle of the humerus, to be distributed to the osseous substance and the membrane lining the medullary canal. nutrient of the bone,

4. The *anastomotic branch* arises from one to two inches above the elbow, and its course is transversely inwards through the inter-muscular septum to the hollow between the olecranon and the inner condyle of the humerus. Here the artery inosculates with the inferior profunda and the posterior ulnar recurrent branch, and gives some branches to the triceps muscle,—one forming an arch across the back of the humerus, with a branch of the superior profunda, near the articulation of the elbow. The anastomotic branch likewise sends an offset in front of the elbow joint, which joins with the anterior ulnar recurrent, and supplies the pronator teres muscle. and anastomotic.

The *brachial veins* are placed along the artery, one on each side, and have branches of communication across that vessel; they receive small veins corresponding to the branches of the arteries. Superiorly they join the axillary vein near the subscapular muscle. Veins end in the axillary.

Peculiarities of the brachial artery.—In the lower half of the arm the brachial trunk may leave the inner border of the biceps muscle, and be directed along the inner intermuscular septum, with the median nerve, to the inner condyle of the humerus. In that case the vessel gains its usual position in front of the elbow by passing beneath or through some fibres of the pronator teres. Its division into the arteries of the fore-arm may take place at any point between the axilla and the common one at the elbow. In a high division the resulting arteries lie usually close together, but one (the ulnar, or the trunk common to the ulnar and the interosseous) may sometimes deviate to the inner side with the median nerve, like the trunk of the brachial artery. In addition, the brachial artery may be covered by a slip of muscular fibres of either the biceps or brachialis anticus. Occasionally there are long slender vessels ("vasa aberrantia") which connect the brachial trunk with the radial or the ulnar artery of the fore-arm. Deviations in position, division, parts covering the vessel; and its branches.

Median nerve in the arm is with the artery;

The *median nerve* arises from the brachial plexus by two roots, one from the outer, and the other from the inner cord of the plexus (p. 227.). Commencing on the outer side of the humeral artery, the nerve crosses over or under the vessel about the middle of the arm, and is found on the inner side a little above the elbow. It does not give any branch in the arm, but there may be a fasciculus connecting it with the musculo-cutaneous nerve. Its connections with muscles are the same as those of the artery.

has not any branch in the arm.

Ulnar nerve changes its direction.

The *ulnar nerve* is derived from the inner cord of the brachial plexus, and lies close to the inner side of the axillary, and of the brachial artery as far as the insertion of the coraco-brachialis. In the remainder of the arm it is directed inwards through the inner intermuscular septum, and then descends, almost surrounded by the muscular fibres of the triceps, to the interval between the olecranon and the inner condyle. There is not any branch given from this nerve till it reaches the elbow joint, but a branch to the triceps muscle from the musculo-spiral accompanies it in the lower part of its course.

Is without branch as far as the elbow.

Internal cutaneous nerve beneath the fascia.

The *internal cutaneous nerve* is to be studied in that small part of its extent which is beneath the fascia of the limb. Arising from the inner cord of the plexus, it is at first internal, and then becomes superficial to the artery of the limb as far as the middle of the arm, where it divides into two branches that perforate the investing fascia (p. 243.). Near the axilla it furnishes the small cutaneous offset to the integuments of the arm, which pierces the fascia higher than the trunk of the nerve (p. 243.).

Nerve of Wrisberg

The *small internal cutaneous nerve* (nerve of Wrisberg*) arises with the preceding, and is concealed at first by the axillary vein. It is directed inwards, either beneath or through the vein, and joins with the intercosto-humeral nerve. Afterwards it lies along the inner part of the arm,

* An account of the discovery and distribution of this nerve is given by Klint. See a paper in Ludwig's "Scriptores Nevrologici Minores," tom. iii. "De Nervis Brachii."

as far as the middle, where it perforates the fascia to end in the integument (p. 243.). *Pierces the fascia.*

Musculo-cutaneous nerve in the arm. The *musculo-cutaneous nerve* (nerv. perforans, Casserii) leaves the outer cord of the plexus at the lower border of the pectoralis minor. It perforates directly the coraco-brachialis, and is directed obliquely to the outer side of the arm, between the biceps and the brachialis anticus muscle. Near the elbow the continuation of the nerve has been seen to become a cutaneous nerve of the fore-arm.

Its muscular branches. This nerve furnishes branches to the muscles in front of the humerus, viz. to the coraco-brachialis, as it passes through the fibres, and to the biceps and ~~coraco-~~brachialis anticus muscles, where it lies between them. Before perforating the coraco-brachialis, the nerve gives a separate twig to that muscle and the short head of the biceps; and sometimes there is a large branch of communication with the median nerve after it pierces the muscle.

Dissection. *Dissection.* — Cut through the tendon of the biceps near the elbow, turn upwards the muscle, and remove any cellular membrane that may obscure the brachialis anticus muscle beneath. The extent laterally of this last muscle should be defined; when this is done, the brachialis will be found to reach the intermuscular septum only on the outer side.

Brachialis anticus. *Origin.* The BRACHIALIS ANTICUS covers the lower half of the front of the humerus, and *arises* from all that surface of the bone below the insertion of the deltoid muscle, except near the elbow joint, and slightly at the outer side: moreover, it receives fibres from the inner intermuscular septum and from the capsule of the joint. The fleshy fibres converge to a tendon, which is *inserted* into the ulna before the coronoid process. *Insertion.* This muscle is concealed by the biceps, the brachial artery, and the median and musculo-cutaneous nerves; and it lies on the humerus and the articulation of the elbow. *Position over the elbow joint, and connections.* Its origin embraces by two parts the attachment of the deltoid, and its insertion is placed between two corresponding fleshy pieces of the flexor profundus digitorum. The inner border touches the intermuscular septum; but the outer border is separated from the septum on that side by two muscles of the fore-arm (supinator longus and extensor carpi radialis

longior), and on it lies the musculo-spiral nerve. The tendon of insertion is to be seen in the dissection of the fore-arm.

Dissection of the back of the arm. *Dissection.*—For the dissection of the back of the arm turn over the limb, and raise it to a semi-flexed position by means of a block of moderate thickness, beneath the elbow. Fasten also the scapula with hooks, in order that the muscular fibres may be rendered tense. Then the detached skin being thrown aside, make a central incision in the fascia to a little below the elbow, and raise it with the subfascial cellular membrane from the surface of the large triceps muscle.

Triceps muscle has three heads. The TRICEPS is the only muscle at the back of the arm. It is divided superiorly into three parts, and it is described as arising by three heads, — inner, outer, and middle. The Origin of middle head, *middle* piece, or head, is the longest, and has a tendinous origin from the lower part of the glenoid cavity of the scapula, and from the contiguous part (about an inch) of the inferior costa of that bone, where it is connected with the of outer head, capsule of the shoulder joint. The *external* head reaches from the outer condyle of the humerus to the insertion of the teres minor muscle, and is attached to the outer part of the posterior surface of the humerus as well as to and of inner head. the intermuscular septum of the same side. The *internal* head arises from the contiguous intermuscular septum, and from the inner part of the posterior aspect of the bone, between the condyle and the insertion of the teres major into the bicipital groove. From these heads of origin the Insertion. fibres are directed to the common tendon of *insertion* at the lower part, which is fixed into the end of the olecranon, and gives an expansion to the aponeurosis of the fore-Direction of the fibres. arm. To reach the tendon the muscular fibres have different inclinations: those of the middle head are directed vertically, but those from the sides of the muscle pass inwards or downwards to the sides and the under part of the tendon. Connections of the muscle. The triceps muscle is superficial, except at the upper part, where it is overlapped by the deltoid muscle. It lies on the humerus, concealing the musculo-spiral nerve, the superior profunda vessels, and the articulation of the elbow. On the sides the muscle is united to the intermuscular septa, and

the lower fibres of the outer head are continuous with the anconeus muscle. A bursa intervenes between the tendon and the end of the olecranon process of the ulna.

The *intermuscular septa* are processes of fibrous structure continuous with the investing aponeurosis of the arm, which are fixed to the ridges leading to the condyles of the humerus: they intervene between the muscles on the front and back of the lower half of the arm, and give attachment to the fleshy fibres. The *internal* is the strongest, and reaches as high as the coraco-brachialis muscle, from which it receives some tendinous fibres. The brachialis anticus is attached to it in front, and the triceps behind; and the ulnar nerve and the inferior profunda and anastomotic arteries pierce it. The *external* septum is thinner, and is placed between the triceps, and the muscles of the fore-arm that arise above the condyle of the humerus: it is pierced by the musculo-spiral nerve.

Two intermuscular septa attached to ridges of humerus. An inner and outer.

Dissection.—To follow the superior profunda artery and the musculo-spiral nerve, cut across the middle head of the triceps over their situation, and remove any cellular membrane that may obscure them. Next divide the triceps muscle in its whole length, and along the line of union of the outer with the middle head, to trace the branches of the nerve and artery that descend to the olecranon and to the anconeus muscle. The trunks of the vessel and nerve may afterwards be followed beneath the outer head of the triceps to the front of the humerus.

Dissection of vessels and nerve.

The *superior profunda* branch of the brachial artery (p. 246.) is the chief vessel for the supply of the triceps muscle. Accompanying the musculo-spiral nerve, it turns to the back of the humerus in the interval between the inner and outer heads of the triceps. In this position the artery supplies large muscular branches, and is then continued onwards beneath the external head of the triceps to the outer part of the arm, where it divides into its terminal twigs: one of these courses on the nerve to the front of the elbow joint, anastomosing with the recurrent radial artery; but others continue to the elbow along the intermuscular septum, and join the interosseous recurrent artery.

Superior profunda artery lies behind the humerus.

Supplies triceps, and forms a circle around joint.

The *muscular* offsets of the vessel descend to the olecranon, supplying the triceps, and communicating with the other branches of the brachial, viz. inferior profunda and anastomotic, as well as with the recurrent branches of the arteries of the fore-arm. One offset deserves especial notice; it accompanies a distinct branch of the musculo-spiral nerve, and ends in the anconeus muscle in the interval between the olecranon and the outer condyle of the humerus.

Musculo-spiral nerve winds behind humerus

The *musculo-spiral nerve* arises from the posterior cord of the brachial plexus, of which it is the largest trunk. At first the nerve is successively behind, and close to the axillary and brachial arteries, but it soon leaves the last vessel, and winds with the profunda artery from the inner to the outer part of the arm, beneath the triceps muscle.

to outer side of the arm.

At the outer aspect of the limb it is continued between the brachialis anticus and supinator longus muscles to the external condyle of the humerus, in front of which it divides into the radial and posterior interosseous nerves. In this extent the nerve gives muscular branches, and cutaneous nerves to both the inner and outer parts of the arm.

Branches.

Internal cutaneous branch.

1. The *internal cutaneous* branch is of small size, and arises in the axillary space, in common with the branch to the inner head of the triceps; it is directed across the posterior boundary of the axillary space to the inner side of the arm, where it becomes cutaneous in the upper third (p. 243.).

Branches to the triceps,

2. The *muscular* branches of the triceps are numerous, and supply all the three heads. One slender offset, that is distributed to the inner head, arises in common with the preceding cutaneous branch, and lies close to the ulnar nerve, till it enters the muscular fibres at the lower third of the arm. And a long slender branch, that appears as if it ended in the triceps, can be followed downwards to the anconeus muscle. On the outer part of the limb the musculo-spiral nerve supplies the brachialis anticus and two muscles of the fore-arm — supinator longus and extensor carpi radialis longior.

brachialis and muscles of fore-arm.

Two external cutaneous.

3. The *external cutaneous* branches are two in number: they perforate the outer head of the triceps at its attachment to the humerus, and are distributed in the integument (p. 243.).

Dissection of the

Dissection.— Now the dissection of the arm is completed as far as the elbow, it will be advisable to examine next the shoulder

joint. To expose the capsule of the joint and a thickened band on its front, it will be necessary to detach from it the tendons of the subscapularis, supra- and infraspinatus, and teres minor, and to remove the cellular membrane. Shoulder joint.

Shoulder Joint. — The articulation of the shoulder has great extent of movement, and the bones entering into its formation are but slightly bound together by ligamentous bands; for on the removal of the muscles, one articular surface drops from the other with great readiness. The joint is formed between the head of the humerus and the glenoid fossa of the scapula, these parts being enclosed in a fibrous capsule. A ligamentous band (glenoid ligament) deepens the shallow cavity for the reception of the humerus. Shoulder joint; how formed.

The *capsular ligament* surrounds the articular ends of the bones, and receives some fibres from the contiguous tendons. By the upper part it is fixed around the neck of the scapula, and is connected with the middle head of the triceps. By the lower part the ligament is attached to the humerus close to the hemispherical articular surface; and its continuity is interrupted between the tuberosities of the bone by the tendon of the biceps muscle. Below the coracoid process, and on the inner side, is an aperture in the capsule through which the synovial membrane of the joint projects beneath the tendon of the subscapularis. The following muscles surround the articulation. Superiorly are the tendons of the supraspinatus, infraspinatus, and teres minor; inferiorly, the capsule is only partly covered by the subscapularis; and internally, it is well supported by the same muscle. Capsular ligament. Attachments. Muscles around.

On the front of the capsule is a thickish band of fibres, — the *coraco-humeral* or *accessory* ligament, which starts from the base of the coracoid process of the scapula, and ends in the great tuberosity of the humerus. Accessory band.

Dissection. — Open the articulation by cutting through the capsule near the scapula. When this is done, the attachment of the capsule to the bones, the glenoid ligament, and the tendon of the biceps will be fully seen. Dissection.

The *tendon of the biceps* muscle arches over the head of the humerus, and serves the purpose of a ligament in re- Tendon of the biceps.

straining the upward movements of that bone. It is attached to the upper part of the glenoid fossa of the scapula, and is connected on each side with the glenoid ligament. As it is directed outwards, it becomes round, and is received into the groove between the tuberosities of the humerus, in which it is confined by a prolongation from the tendon of the pectoralis major muscle.

Glenoid ligament. The *glenoid ligament* is a firm, fibrous band that surrounds the fossa of the same name, deepening it for the reception of the head of the humerus. It is about two lines deep, and is connected with the sides of the tendon of the biceps: some of its fibres are fixed to the edge of the glenoid fossa.

Synovial membrane. The *synovial membrane* lines the articular surfaces of the bones, and is continued from the one to the other along the fibrous capsule. At the aperture in the capsule, on the inner side of the joint, a prolongation is continued beneath the subscapularis muscle. The membrane is further reflected around the tendon of the biceps, and lines the bicipital groove of the humerus.

Section IV.

THE FRONT OF THE FORE-ARM.

Position of the limb. *Position.* — Place the limb with the palm of the hand uppermost, and proceed to examine the marking of the surface, and the projections of bone.

Surface of the fore-arm. *Surface-marking.* — On the anterior aspect of the fore-arm are two depressions, corresponding to the position of the vessels. The external one is placed over the radial artery, and inclines towards the middle of the fore-arm as it approaches the elbow. The internal one is evident only beyond the middle of the fore-arm, and points out the part of the ulnar artery that is uncovered by muscle. The bones (radius and ulna) are sufficiently near the surface to be traced in their whole length: each ends below in a point, the styloid process, that of the radius being the lowest. The articula-

tion of the wrist is about an inch above the transverse markings that separate the hand from the fore-arm.

In the palm of the hand are seen two lateral projections, of which the external one is formed by the muscles of the thumb, and the internal one by the muscles of the little finger. Between the projections is a hollow which is pointed towards the wrist. The superficial palmar arch of arteries extends forwards a little way into the hollow, and its position may be found by a line drawn across the palm from the root of the thumb, when this is placed at a right angle to the hand. Two transverse lines are seen in the palm; and the anterior one serves to direct to the line of the articulations between the metacarpus and the phalanges, which is about a quarter of an inch in front of that mark, when the fingers are extended. Surface of palm of the hand.

Transverse lines are seen on both aspects of the joints of the thumb and the fingers. The lines on the palmar surface of the fingers are used to point out the articulations of the phalanges. Thus the joint between the metacarpal phalanx and the next will be found about a line in front of the last of the transverse grooves marking that spot; whilst the articulation between the two last phalanges is situate about a line in front of the corresponding groove on the finger. Surface of the fingers.

Dissection.—With the position of the limb still the same, make an incision through the skin along the middle of the front of the fore-arm as far as the wrist, and at its termination at this spot unite it with a transverse one. Now reflect carefully the skin from the front and the back of the fore-arm, without injuring the numerous superficial vessels and nerves that are beneath. The skin should next be taken from the back of the hand, by prolonging the ends of the transverse cut along the margins of the hand as far as the knuckles. A finger might also have the integument removed from it, in order to trace the nerves to the end. Dissection to remove the skin.

Next follow in the fat the superficial vessels and nerves. Along the inner side of the fore-arm are the ulnar veins, with the continuation of the internal cutaneous nerve; and near the wrist there is occasionally a small offset from the ulnar nerve. On the outer side are the radial vein and the superficial part of the musculo-cutaneous nerve. Close to the hand, and in the middle of the fore-arm, is the small palmar branch of the median nerve. At the Seek the superficial vessels and nerves.

back of the fore-arm the external cutaneous branch of the musculo-spiral nerve is distributed, and offsets turn to this aspect from the nerves in front. On the posterior part of the hand is an arch of superficial veins; and the radial nerve and a branch of the ulnar nerve ramify on the back of the hand and fingers.

Subcutaneous veins of the fore-arm are

Cutaneous Veins. — The superficial veins of the fore-arm are named median, radial, and ulnar, from their position in the limb. They commence in the hand, chiefly at the dorsal aspect, where they form an arch, and are continued along the fore-arm to end in the basilic and cephalic veins of the arm.

Arch on the hand.

On the back of the hand is a superficial *arch* of veins, more or less perfect, which receives the posterior or superficial digital veins. At the sides, the arch terminates in the radial and ulnar veins of the fore-arm.

radial;

The *radial vein* begins by the union of some small veins from the back of the thumb with the outer part of the arch before mentioned. It is then continued along the fore-arm, at first behind, and then along the outer border as far as the elbow, where it gives rise to the cephalic vein by joining the outer branch of the median vein (median cephalic).

ulnar: two sets, anterior

The *ulnar veins* are anterior and posterior, and occupy the front and the back of the fore-arm. The *anterior* arises near the wrist, by the junction of small veins from the hand and fore-arm, and runs on the inner part of the fore-arm to the elbow; it forms the basilic vein by uniting with the inner branch of the median vein (median basilic). The *posterior* ulnar vein is situate on the back of the limb. It commences at the hand, by the union of a large vein ("vena salvatella") from the back of the little finger with the offset of the venous arch; it is then continued along the back of the fore-arm, nearly to the elbow, and bends forwards to open into the anterior ulnar vein.

and posterior;

median.

The *median vein* commences on the front of the arm, near the wrist, by small branches, which are derived from the palmar surface of the hand; and it is directed along the centre of the fore-arm nearly to the elbow. Here the vein divides into external and internal branches (median basilic and median cephalic), which unite, as before seen, with the radial and ulnar veins. At its point of bifurcation the median vein receives a communicating branch from a deep vein.

Superficial nerves of fore-arm

CUTANEOUS NERVES. — In the fore-arm the superficial nerves are the continuation of the cutaneous nerves of the arm, viz. the large internal cutaneous nerve on the inner part, and the two external cutaneous nerves, derived from the musculo-spiral and musculo-cutaneous, on the outer part. Occasionally there is a small offset of the ulnar nerve in the fore-arm. On the back of the hand is the termination of the radial nerve, together with a branch of the ulnar nerve.

and back of hand are

internal cutaneous

The *internal cutaneous nerve* was seen in a previous dissection (p. 243.) to be divided into two parts. The *anterior* branch extends on the front of the fore-arm as far as the wrist, and supplies the integument on the inner part of the anterior aspect. Near the wrist it communicates sometimes with a cutaneous offset from the ulnar nerve. The *posterior* branch continues along the back of the fore-arm (ulnar side) to rather below the middle.

musculo or external cutaneous;

The *cutaneous part* of the musculo-cutaneous nerve is continued from the arm, and courses along the radial border of the fore-arm as far as the ball of the thumb, on which it terminates in cutaneous offsets. Near the wrist the nerve is placed over the radial artery, and some twigs pierce the fascia to ramify on the vessel. A little above the middle of the fore-arm the nerve gives backwards to the integument on the posterior aspect a branch that reaches nearly to the wrist, and communicates with the radial nerve as well as with the following cutaneous nerve.

external cutaneous of musculo-spiral.

The *external cutaneous branch* of the musculo-spiral nerve, after passing the elbow, turns to the posterior aspect of the fore-arm, and reaches as far as the wrist. Near its termination it joins the preceding cutaneous nerve.

Ending of the radial nerve

The *radial nerve* is distributed to the integument of the back of the hand and to that of the thumb and the next two fingers. It becomes cutaneous at the outer border of the fore-arm in the lower third, and after giving backwards some filaments to the posterior aspect of the limb, divides into two branches.

by external and internal branch;

a. One (external) is joined by the musculo-cutaneous nerve, and is distributed to the radial border and the ball of the thumb. *b.* The other branch (internal) supplies the remaining side of the thumb, both sides of the next two fingers, and half the ring finger; so that the radial nerve supplies the same number of digital nerves on the dorsal aspect as the median furnishes on the palmar aspect. This division of the radial nerve is joined by the musculo-cutaneous and ulnar nerves; and the offset, which is distributed to the contiguous sides of the ring and

which supply the fingers.

middle fingers, is joined by a twig from the dorsal branch of the ulnar nerve.

Termination. On the sides of the fingers each dorsal digital nerve is united with an offset from the digital nerve of the palmar aspect, and extends to the tip of the finger.

Branch of ulnar nerve to back of hand and fingers. The *dorsal branch* of the *ulnar nerve* furnishes branches to the rest of the fingers and to the back of the hand. Appearing by the styloid process of the ulna, the nerve joins in an arch across the back of the hand with an offset from the radial nerve, and is then distributed to both sides of the little finger, and to the contiguous side of the ring finger: moreover, it communicates with the branch of the radial nerve that supplies the space between the ring and middle fingers. The ulnar nerve supplies digital branches to the same number of fingers on both surfaces (palmar and dorsal).

Deep fascia of the fore-arm. The *aponeurosis* of the fore-arm is continuous with a similar investment of the arm, and surrounds the muscles in a sheath. It is of a pearly white colour, and is formed of fibres that cross obliquely, constituting a membrane which is thicker behind than before, and is stronger near the elbow than towards the hand. On the front. Near the elbow it receives fibres from the tendons of the biceps, brachialis anticus, and the muscles attached to the inner condyle of the humerus. At the wrist the fascia joins the anterior annular ligament; and near this band, the tendon of the palmaris longus pierces the fascia, and receives a sheath from it. On the back of the limb. On the back of the fore-arm, the aponeurosis is connected to the margins of the ulna, leaving the upper part of that bone subcutaneous; and it receives some fibres from the tendon of the triceps. Behind the wrist it is thickened by transverse fibres, and gives rise to the posterior annular ligament; and on the back of the hand and fingers the fascia becomes very thin and cellular. Inter-muscular pieces. Horizontal processes are sent downwards from the aponeurosis to separate the superficial and deep layers of muscles both on the front and on the back of the fore-arm; and longitudinal white bands indicate the position of the different intermuscular processes, which separate one muscle from another, and give origin to the muscular fibres.

Dissection.—Replace the skin on the back of the hand and the fore-arm, in order that the parts that are exposed may not become dry. Taking, first, the dissection of the anterior aspect of the limb, let the student divide the aponeurosis along the front of the fore-arm as far as the wrist, and take it away with the cutaneous vessels and nerves, except the small cutaneous offsets of the median and ulnar nerves near the wrist. In cleaning the muscles, it will be impossible to remove the aponeurosis from them at the upper part of the fore-arm without detaching the muscular fibres. Take away fascia, nerves, and vessels.

After the aponeurosis is removed, the termination of the brachial artery will be observed to lie in some fat in a hollow in front of the elbow, between two masses of muscles,—one arising from the inner, and the other from the outer condyle of the humerus. Two large arteries are also exposed; one (radial) lies along the radial border of the fore-arm, the other (ulnar) is superficial only in the lower half of the fore-arm, and at the ulnar side. Vessels then seen.

Next expose the anterior annular ligament of the wrist which arches over the tendons passing from the fore-arm to the hand. This structure is at some little depth from the surface, and it may be necessary to take away more of the skin to make it apparent, but in so doing care must be taken of the small branches of the median and ulnar nerves to the palm of the hand. The ulnar artery and nerve pass over the ligament, and will serve as a guide to it. Define anterior annular ligament.

Hollow in front of the elbow.—Between the inner and the outer mass of the muscles, in front of the bend of the elbow, is a hollow which resembles that of the popliteal space in the leg. This interval is somewhat triangular in shape, and the wider part is towards the humerus. On the outer side it is bounded by the supinator longus muscle, and on the inner side by the pronator teres. The aponeurosis of the limb is stretched over the space; and the bones of the arm covered by the brachialis anticus muscle form the deep boundary. Hollow in front of the elbow.

In this hollow are contained the termination of the brachial artery, the median nerve, the musculo-spiral nerve, the tendon of the biceps muscle, and some cellular membrane: these several parts have the following relative position in the space. The tendon of the biceps is directed towards the outer boundary to reach the radius, into which it is inserted; and the musculo-spiral nerve is close to the outer Contents of the space and their position to one another.

side, being partly concealed by the supinator longus muscle. The brachial vessels and the median nerve occupy nearly the centre of the space, the nerve being internal; but as the artery is inclining to the outer, and the nerve to the inner part of the limb, they are soon distant from one another about half an inch. In this space the brachial artery divides into two trunks—radial and ulnar.

Superficial layer has five muscles.

Muscles on the front of the fore-arm.—The muscles on the anterior and inner parts of the fore-arm are divided into a superficial and a deep layer. In the superficial layer there are five muscles, which are fixed to the inner condyle of the humerus, and have the undermentioned position from the outer to the inner side; pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, which are on the same level; and deeper and larger than any of these is the flexor sublimis digitorum. The deep layer will be met with in a future dissection.

Pronator teres.

Origin.

Insertion.

The PRONATOR RADII TERES arises from the inner condyle of the humerus by a tendon common to the muscles of the superficial layer; from the inner part of the coronoid process by a second tendinous slip; from the fascia, and from the intermuscular septum between it and the next muscle. It is *inserted* by a rather flat tendon into an impression on the outer surface of the radius, about the middle of the bone. The muscle is superficial, except at its insertion, where it is crossed by the radial artery, and concealed by the supinator longus of the outer set of muscles. The outer border constitutes one boundary of the triangular space in front of the elbow, and the inner border is contiguous to the flexor carpi radialis. By gently separating the muscle from the rest, it will be found to conceal the brachialis anticus, the flexor sublimis digitorum, the ulnar artery, and the median nerve. The second small head of origin is directed inwards between the artery and the nerve.

Connections.

Radial flexor of the wrist

The FLEXOR CARPI RADIALIS takes its origin from the common tendon, from the aponeurosis of the fore-arm, and from the intermuscular septum on each side. The fleshy fibres end in a tendon about the middle of the fore-arm, which passes through a groove in the os trapezium, and is *inserted*

into the base of the metacarpal bone of the index finger. This muscle rests chiefly on the flexor sublimis digitorum, but near its origin it is in contact with the ulnar artery and the median nerve; and at the lower part of the fore-arm it lies over the flexor longus pollicis, a muscle of the deep layer. As low as the middle of the fore-arm the muscle corresponds externally to the pronator teres, and below that point to the radial artery, to which its tendon is taken as the guide. The ulnar border is at first in contact with the palmaris longus muscle, and lastly with the median nerve for about two inches above the wrist.

is superficial;

is the guide to the radial artery.

The PALMARIS LONGUS is often absent, or presents great irregularity in the proportion between its fleshy and tendinous parts. Its origin is like that of the preceding muscle, viz. from the common tendon, the fascia, and the intermuscular septa; and its long thin tendon is continued through the centre of the fore-arm, and over the annular ligament to end in the palmar fascia. The palmaris is situate between the flexor carpi radialis and flexor carpi ulnaris muscles, and rests on the flexor sublimis digitorum.

Long palmar muscle

lies over annular ligament, and ends in fascia of palm.

Flexor carpi ulnaris.

Origin.

The FLEXOR CARPI ULNARIS arises from the inner condyle of the humerus, from the inner side of the olecranon, and from an aponeurosis, which is fixed to the ridge of the ulna, between the internal and external surfaces. The fibres of origin reaching nearly to the wrist are continued downwards or obliquely forwards to a tendon which occupies the anterior aspect of the muscle in its lower half, and is *inserted* into the pisiform bone, an offset being given to the annular ligament and to the muscles of the little finger. One surface of the muscle is in contact with the fascia; and its tendon is the guide to the ulnar artery, being readily felt through the skin. To its radial side are the palmaris and flexor digitorum sublimis muscles, but below the middle of the fore-arm the ulnar artery and nerve are in relation with it. When the attachment to the inner condyle is divided, and the subjacent parts cleaned, the muscle will be seen to conceal the flexor digitorum sublimis and flexor profundus, the ulnar nerve, and the ulnar vessels in part. Between the attach-

Insertion into pisiform bone.

Adjacent parts.

ments to the condyle and the olecranon the ulnar nerve enters the fore-arm.

Course and extent of the radial artery.

The RADIAL ARTERY is one of the divisions of the brachial trunk, and extends along the outer side of the fore-arm to the end of the radius; it then winds backwards below the end of that bone, and finally enters the palm of the hand through the first interosseous space. In consequence of this circuitous course the anatomy of the artery will be found in three different dissections; viz. the front of the fore-arm, the back of the wrist, and the palm of the hand.

Situation in the fore-arm.

In the front of the fore-arm.—In this part of the limb the course of the artery will be marked on the surface by a line drawn from the centre of the hollow of the elbow to the styloid process of the radius. This vessel is smaller than the ulnar artery, though it appears to be the continuation of the brachial trunk.

Connections with parts over it,

In all its extent the radial artery is quite superficial, being covered only by the common tegumentary investments and the deep fascia, and near the wrist it can be felt pulsating during life. Its connections with the surrounding muscles and the radius are these: in the upper half of the fore-arm the artery is placed between the fleshy bellies of the supinator longus externally and the pronator teres internally, the former somewhat overlapping it; but below that point the vessel lies in a hollow between the tendons of the supinator longus and flexor carpi radialis muscles. At first the vessel is on the inner side of the radius, but afterwards it lies over that bone and the muscles that are successively attached to it, viz. the fleshy supinator brevis, the tendon of the pronator teres, the thin radial origin of the flexor sublimis, some muscles of the deep layer, viz. flexor pollicis longus and pronator quadratus, and lastly on the end of the radius. The usual venæ comites are found on the sides of the artery. The radial nerve is on the outer side of, though not in contact with the vessel, in the upper two-thirds of the fore-arm, or until it passes beneath the tendon of the supinator longus.

on the sides, behind, and with the radius.

Veins and nerve with it.

Branches both muscular and

Branches.—The radial artery furnishes in the fore-arm many unnamed muscular and nutrient branches to the sur-

rounding parts; and three named branches, viz. recurrent radial, superficial volar, and anterior carpal. Anastomotic.

1. The *radial recurrent* is the first branch of the artery, and supplies for the most part the muscles of the outer side of the fore-arm. Its course is almost transverse to the supinator longus muscle, beneath which it terminates in muscular branches. One branch ascends beneath the supinator, to anastomose with the superior profunda branch of the brachial artery. Radial recurrent.

2. The *superficial volar* branch usually arises near the lower end of the radius, but its exact place of origin is uncertain. It is directed to the palm of the hand, across the mass of muscle in the ball of the thumb, and it either ends in those muscles, or joins the superficial palmar arch. Superficial volar.

3. The *anterior carpal* branch is very inconsiderable in size, and will be seen in the examination of the deep layer of muscles. Arising rather above the lower end of the radius, this artery passes transversely beneath the muscles to anastomose with a similar branch from the ulnar artery. From the arch thus formed at the lower border of the pronator quadratus muscle offsets are given to the carpus. Anterior carpal.

Peculiarities of the radial artery.—The origin of the artery is often carried upwards in the arm, from the usual place even to the axilla; but in one instance (Quain) it was noticed three inches below the elbow joint, and in that case a vas aberrans connected it with the axillary artery. When the radial artery has the high unusual origin, its course in the arm is close to the brachial artery, along the edge of the biceps muscle; but in passing the bend of the elbow it may be subcutaneous, and therefore mistaken for a vein in venesection. In the fore-arm it may likewise be subcutaneous, and superficial to the supinator longus muscle. Variations in the origin and course of the radial.

The *vasa aberrantia*, or long slender branches of the axillary or brachial trunks, generally open into the radial artery. In cases of high origin of the radial, there is sometimes a connecting branch at the bend of the elbow, between that irregular vessel and the trunk in the place of the brachial artery. Connecting branches.

Dissection.—Cut through the origin of the flexor carpi radialis and palmaris longus, near the inner condyle of the humerus, and turn these muscles to one side. Small branches of the ulnar artery and median nerve will be seen to enter the under surface of the muscles. For the present, the pronator teres may be left uncut. The remaining muscle of the superficial layer (flexor sublimis digitorum) is now exposed in the fore-arm. Dissection.

Superficial flexor of fingers.

The FLEXOR DIGITORUM SUBLIMIS vel PERFORATUS is the largest of the muscles of the superficial layer, and is named from its position with reference to another flexor in the deep layer of muscles.

Origin.

It *arises* from the inner condyle of the humerus, from the intermuscular septa, in common with the preceding muscles, and from the internal lateral ligament; it also takes origin from the bones of the fore-arm, viz. from the inner part of the coronoid process of the ulna, and from the oblique line on the radius as far as two inches below the insertion of the pronator teres. Rather below the middle of the fore-arm the muscle ends in four tendons, which are continued

Insertion.

across the hand to be *inserted* into the middle phalanges

Its tendons pierced by deep flexor.

of the fingers, after being perforated by the tendons of the deep flexor.

Connections with parts around.

The flexor sublimis is concealed by the other muscles of the superficial layer, and the radial vessels lie on the attachment to the radius. Along the inner border is the flexor carpi ulnaris with the ulnar vessels and nerve. The tendons of the muscle are arranged in pairs before they enter beneath the annular ligament of the wrist; those of the middle and ring fingers being anterior, and those of the index and the little finger posterior in position. When the coronoid and condyloid attachments are divided, the muscle is seen to cover two flexors of the deep layer (flexor digit. profundus and flexor pollicis), the median nerve, and the upper part of the ulnar artery.

Ulnar artery ends in palm of hand.

The ULNAR ARTERY is the larger branch of bifurcation of the brachial trunk, and is directed along the inner side of the fore-arm to the palm of the hand, where it forms the superficial palmar arch.

Connections in the upper

In the fore-arm the vessel has an arched direction, and its depth from the surface varies in the first and last parts of its course. In the upper half of the fore-arm the artery is inclined obliquely inwards between the superficial and deep layers of muscles, and is covered by the former, viz. pronator teres, flexor sublimis, palmaris longus, and flexor

and lower half of the fore-arm.

carpi radialis. But below the spot mentioned the vessel is quite superficial between the tendons of the flexor sublimis and flexor carpi ulnaris, and is concealed only by the common integuments and the proper fascia of the limb, though

the flexor ulnaris somewhat overlays it, and serves as the guide to its position. Beneath the artery will be found first the brachialis anticus for a short distance, and afterwards the flexor profundus.

The two companion veins are situate on the sides of the artery. The median nerve lies to the inner side of the vessel for about an inch, but afterwards crosses over the artery to gain the outer side. About the middle of the fore-arm, the ulnar nerve approaches the artery, and continues thence on the inner side. A small branch of the ulnar nerve descends on the lower part of the artery in its course to the palm of the hand. Position of veins and nerves.

On the annular ligament of the wrist, the artery lies close to the pisiform bone, and is crossed by a band of fibres prolonged from the tendon of the flexor carpi ulnaris to that ligament. The ulnar nerve still accompanies the vessel, having the same position, viz. on the inner side. Position on the annular ligament.

Branches.—The greater number of the collateral branches of the artery are distributed to the muscles. But the branches which are named are the following:— Its branches besides muscular are

1. The *anterior ulnar recurrent* branch arises generally in common with the next, and turns upwards on the brachialis anticus muscle, to inosculate with the small anastomotic artery beneath the pronator radii teres. It gives offsets to the contiguous muscles. anterior and

2. The *posterior ulnar recurrent* branch, of larger size than the anterior, is directed inwards beneath the flexor sublimis muscle to the interval between the inner condyle and the olecranon. Here it passes with the ulnar nerve between the attachments of the flexor carpi ulnaris, and joins the ramifications of the inferior profunda and anastomotic arteries on the inner side of the elbow joint. Some of its offsets enter the muscles, and others supply the articulation and the ulnar nerve. posterior recurrent,

3. The *interosseous* branch is a short, thick trunk, about an inch long, that is directed backwards towards the interosseous membrane, and divides into anterior and posterior interosseous arteries: these branches will be afterwards followed. interosseous,

4. The *metacarpal* branch arises from the artery near the lower end of the ulna, and turns back along the metacarpal bone of the little finger, of which it forms a dorsal branch. metacarpal.

and carpal.

5. The *carpal* branches (anterior and posterior) ramify on the front and back of the carpus, on which they anastomose with corresponding offsets of the radial artery, forming arches across the wrist.

The origin and course of the artery may vary.

Peculiarities of the ulnar artery.— The place of origin has a tendency to approach the trunk of the body, and it may therefore be changed to the axilla, or to any point along the arm. Once the origin was found below the elbow. (Quain.) Its position in the fore-arm, when the vessel is irregular, is more frequently changed than that of the radial under similar conditions. Commonly, in the instances of high origin, the ulnar artery is superficial to the flexor muscles at the bend of the elbow, but beneath the aponeurosis of the fore-arm, though sometimes it is subcutaneous with the superficial veins.

Ulnar nerve in the fore-arm.

The ULNAR NERVE enters the fore-arm between the attachments of the flexor carpi ulnaris to the olecranon and inner condyle of the humerus. Under cover of that muscle the nerve reaches the ulnar artery about the middle (in length) of the fore-arm, and is then continued on the inner side of the vessel to the hand. On the annular ligament the nerve is rather posterior to the artery. In the fore-arm it furnishes articular, muscular, and cutaneous branches as below:—

Its branches are

to elbow joint,

1. *Articular nerves.*—In the interval between the olecranon and the inner condyle, the ulnar nerve gives slender filaments to the articulation against which it lies.

two muscles of fore-arm,

2. *Muscular branches.*— It furnishes offsets to two muscles of the fore-arm, viz. flexor carpi ulnaris and flexor profundus. One branch enters the upper part of the flexor carpi ulnaris, and another supplies the inner half of the flexor profundus digitorum.

cutaneous branch of palm of hand,

3. *Cutaneous nerve of the fore-arm and hand.*—About the middle of the fore-arm a small cutaneous branch (palmar) arises from the nerve, and continues on the ulnar artery, sending twigs around it, to end in the integuments of the palm of the hand. Sometimes a cutaneous offset of it perforates the aponeurosis of the fore-arm, and joins the internal cutaneous nerve.

cutaneous nerve of back of hand.

4. The *dorsal cutaneous nerve of the hand* arises about two inches above the end of the ulna, and passes obliquely backwards beneath the flexor carpi ulnaris muscle: it finally perforates the aponeurosis of the limb, and is lost on the back of the hand and the fingers (see p. 258.).

The MEDIAN NERVE leaves the hollow of the elbow between the heads of origin of the pronator teres, and takes the middle line of the fore-arm in its course to the hand. It is placed beneath the flexor sublimis as low as two inches from the annular ligament, but it then becomes superficial along the outer border of the tendons of this muscle. Lastly the nerve dips beneath the annular ligament to enter the palm of the hand, where it is distributed. This is the muscular nerve of the front of the fore-arm, and it furnishes cutaneous offsets only to the hand.

Median nerve lies between the two layers of muscles.

1. *Muscular offsets* leave the trunk of the nerve near the elbow, and are distributed to all the muscles of the superficial layer in front of the fore-arm, except the flexor carpi ulnaris, and to a part (outer half) of one muscle of the deep layer, the flexor profundus digitorum.

Supplies the muscles, except one and a half,

2. The *anterior interosseous nerve.*—By means of this nerve, the remaining muscles of the deep layer are supplied. It accompanies the anterior interosseous artery, and will be dissected with that vessel.

in both layers.

3. The *cutaneous palmar branch* arises at the lower part of the fore-arm; it pierces the fascia near the annular ligament, and crosses the ligament to reach the palm of the hand.

A cutaneous branch to palm of hand.

The RADIAL NERVE is one of the branches of division of the musculo-spiral in front of the outer condyle of the humerus. This nerve is placed along the outer border of the fore-arm, under cover of the supinator longus, and on the outer side of the radial artery till within three inches of the wrist, where it becomes cutaneous at the posterior part of the tendon of the supinator. On the surface it divides into two branches which are distributed on the dorsum of the hand, and on the thumb and the next two fingers (p. 257). No offset is furnished by the part of the nerve beneath the aponeurosis.

Radial nerve in the fore-arm, ends on back of the hand.

Dissection.—To examine the deep layer of muscles it will be necessary to draw well over to the radial side of the fore-arm the pronator teres and flexor sublimis muscles; or, if it is thought necessary, these muscles may be divided. The cellular tissue is to be taken from the muscular fibres, and the anterior interosseous vessels and nerve which lie on the interosseous membrane, and are concealed by the muscles, are to be traced out.

Dissection of deep layer of muscles.

Three muscles in the deep layer.

Deep layer of muscles. — Only three muscles are present in this layer. One lies on the ulna, and is the deep flexor of the fingers; another covers the radius, — the long flexor of the thumb; and the third is the pronator, which is beneath the other two, near the lower end of the bones.

Deep flexor of fingers.

Origin.

Is attached to last phalanges.

Parts around it.

The FLEXOR DIGITORUM PROFUNDUS vel PERFORANS arises from the anterior and inner surfaces of the ulna for three-fourths of the length of the bone, from the inner half of the interosseous ligament, from the inner part of the olecranon, and from an aponeurosis common to this muscle and the flexor carpi ulnaris. The muscle has a thick fleshy belly, and ends in four tendons, which are not separate above the annular ligament, and whose destination is the last phalanges of the fingers. The cutaneous surface of the muscle is in contact with the ulnar nerve and vessels, the superficial flexor of the fingers, and the flexor carpi ulnaris; and the deep surface rests on the ulna and the pronator quadratus muscle. The outer border touches the flexor pollicis longus and the anterior interosseous vessels and nerve; and the inner is connected by the aponeurosis to the posterior margin of the ulna.

Long flexor of thumb.

Origin.

Insertion.

Parts above

and beneath it.

The FLEXOR LONGUS POLLICIS arises from the anterior surface of the radius as low as the pronator quadratus, from the outer part of the interosseous membrane, and by a round distinct slip from the coronoid process of the ulna. The fleshy fibres descend to a tendon, which is continued beneath the annular ligament to be *inserted* into the last phalanx of the thumb. On the cutaneous surface of the muscle is the flexor sublimis, together with the radial vessels for a short distance inferiorly; and the muscle lies on the radius and the pronator quadratus. To the inner side is the flexor profundus digitorum.

Pronator quadratus is on lower end of bones of fore arm

is deep in position.

The PRONATOR QUADRATUS is a flat muscle, and occupies the front of the bones of the fore-arm in their lower fourth. The muscle *arises* from the anterior and inner parts of the ulna, where it is somewhat the widest, and is *inserted* into the fore part of the radius for about two inches. The anterior surface is covered by the tendons of the flexor muscles of the fingers, and by the radial artery; and the

posterior surface rests on the radius and ulna with their intervening membrane, and on the interosseous vessels and nerve.

The *anterior interosseous artery* (p. 265.) is continued on the front of the interosseous membrane, between or in the fibres of the deep flexor muscles, till it reaches the aperture below that membrane. At this spot the artery turns from the front to the back of the fore-arm, and descends to the posterior aspect of the carpus, where it ends by anastomosing with the posterior carpal arteries. Anterior interosseous artery.

Branches. — Numerous offsets are given to the contiguous muscles. One long branch (median) accompanies the median nerve, supplying it, and either ends in the flexor sublimis, or extends beneath the annular ligament to the hand. About the middle of the fore-arm the nutrient arteries of the bones arise from the artery. Where it is about to turn backwards, it furnishes twigs to the pronator quadratus, and one branch is continued beneath that muscle to anastomose with the anterior carpal arteries. Its branches chiefly muscular.

The *anterior interosseous nerve* is derived from the median (p. 267.), and accompanies the artery of the same name to the pronator quadratus muscle, on the under surface of which it ends. Some lateral branches are distributed by it to the deep flexor muscles. Anterior interosseous nerve ends in pronator.

Section V.

THE PALM OF THE HAND.

Dissection. — Place the palm of the hand upwards, and raise the skin from it by means of two incisions. One is to be carried along the centre of the hand from the wrist to the fingers, and the other is to be made from side to side at the termination of the first. In raising the inner flap, the small palmaris brevis muscle will be recognised at the inner margin of the hand, near the wrist. In the fat will be found the ramifications of the small branches (palmar) of the median and ulnar nerves. Dissection. Seek the cutaneous nerves.

Take away now the fat from the small palmar muscle and strong palmar fascia, and be careful not to destroy a thin transverse band of tissue (transverse ligament) that passes across the Define the palmar fascia.

roots of the fingers. When cleaning the fat from the palmar fascia the dissector will observe the digital vessels and nerves, especially those of the inner side of the little finger and outer side of the index finger, which appear farther back than the rest, and are most likely to be injured. Lastly, remove the skin and the fat from the thumb and the fingers, so as to expose the sheaths of the tendons with the collateral vessels and nerves.

and expose sheaths.

Two cutaneous palmar nerves.

Cutaneous palmar nerves. — Two named cutaneous nerves ramify in the palm of the hand. *a.* One of these is an offset of the median nerve (p. 267.), and crosses the annular ligament: it extends to about the middle of the palm, and is connected with the branch of the ulnar nerve. A few filaments of this nerve are furnished to the ball of the thumb. *b.* The other palmar branch is an offset of the ulnar nerve: it has been already traced on the ulnar artery to the hand, and it may now be followed to its distribution in the palm.

One of median, other of ulnar nerve.

Some unnamed twigs.

Some unnamed twigs are also furnished to the integument from both the median and ulnar nerves in the hand.

Palmaris brevis is subcutaneous, and ends in the skin.

The PALMARIS BREVIS is a small subcutaneous muscle, about an inch wide, whose fibres are collected into separate bundles. It is attached on the one side to the palmar aponeurosis and the annular ligament, and its fibres are directed inwards to join the skin at the inner border of the hand. This muscle lies over the ulnar artery and nerve. After it has been examined, it may be thrown inwards.

Palmar fascia.

The *palmar fascia*, or aponeurosis, consists of a central and two lateral parts; but the latter, which cover the muscles of the thumb and little finger, are so thin as not to require separate notice.

Its central part

The central part is a strong, white, shining layer, which is pointed at the wrist, but expanded towards the fingers, where it covers nearly the whole width of the hand. Posteriorly, this part of the fascia receives the tendon of the palmaris longus, and is connected to the annular ligament; and anteriorly it ends in four processes, which are continued forwards, one for each finger, to join the sheaths of the tendons. At the point of separation of the processes one from another, are placed some transverse fibres, which arch over the lumbricalis muscle and the digital artery and nerve that appear at this spot. A few superficial fibres are

ends in a piece for each finger.

prolonged from the four divisions before mentioned, to the integument at the cleft of the fingers, and to the transverse ligament.

Dissection.—To follow a process of the fascia to its junction with the sheath of the tendons, remove its superficial fibres, and inserting the knife beneath it, opposite the head of the metacarpal bone, divide it longitudinally. Dissection.

Each process of the fascia will be now seen to send downwards an offset on each side of the tendons, which is fixed to the ligament connecting together the ends of the metacarpal bones, as well as to the borders of the bone for a short distance. Ending of t pieces of fascia.

The *transverse ligament of the fingers* is a thin fibrous band, which stretches across the roots of the fingers, and is contained in the fold of skin limiting the clefts between them. Beneath it the digital nerves and vessels are continued onwards to their termination. Ligament of the fingers.

Sheath of the flexor tendons.—Along each finger the flexor tendons are retained in position against the phalanges by a fibrous sheath. Opposite the middle of each of the two nearest phalanges, the sheath is formed by a strong fibrous band, which is almost cartilaginous in hardness; but opposite the joints of the fingers it consists only of scattered fibres, that form a thin membrane. When the sheath is opened, it will be found to be lined by a synovial membrane that lubricates the tendons. Sheath of the tendons varies in thickness. Has a synovial sac.

Dissection.—Take away the palmar fascia and the thinner parts of the sheaths of the tendons opposite the joints of the fingers. The palmar arch of arteries and the median and ulnar nerves now come into view. Dissection.

Palmar Part of the Ulnar Artery. — After crossing the annular ligament, the ulnar artery is directed outwards in the palm of the hand towards the muscles of the thumb, where it communicates with the radial artery through the superficial volar branch and the arteria radialis indicis. The part of the artery that lies across the hand is named the *superficial palmar arch.* Its direction is arched towards the fingers, and its position in the palm would be Superficial palmar arch. Position in the hand and

nearly marked by a line across the hand from the centre of the cleft between the thumb and the index finger. The arch is quite superficial, and is covered only by the integuments and the palmar fascia, except at the inner border of the hand, where the palmaris brevis muscle overlays it. Beneath it are the flexor tendons and the branches of the ulnar and median nerves.

connections.

Branches are

Branches. — From the convexity of the arch proceed the digital arteries, and from the concavity, some small offsets to the palm of the hand. A small branch (profunda) arises as soon as the artery enters the hand.

to join the deep arch.

1. The *communicating* (profunda) *branch* is of very small size, and passes downwards with a branch of the ulnar nerve, between the abductor and short flexor muscles of the little finger, to inosculate with the deep palmar arch of the radial artery.

Four digital branches.

In the hand.

2. The *digital branches* are four in number, and supply both sides of the three inner fingers and one side of the index finger. The branch of the inner side of the hand and little finger is undivided in its course; but the others correspond to the three inner interosseous spaces, and bifurcate anteriorly to supply the contiguous sides of the above said fingers. In the hand these branches are accompanied by the digital nerves, which they sometimes pierce. Near the root of the fingers each receives a communicating branch from the arteries of the deep arch; but the branch for the inner side of the little finger has its communicating branch about the middle of the hand.

Termination on sides of the fingers.

From the point of bifurcation the branches extend along the sides of the fingers, accompanied by the digital nerves, and on the last phalanx the vessels of opposite sides unite in an arch, from whose convexity offsets proceed to supply the papillæ of the tip of the finger, as well as the pulp beneath the nail. Lateral branches are also furnished to the finger and the sheath of the tendons; and some small twigs are supplied to the phalangeal articulations from a small arterial arch on the bone, close behind each joint.

Ulnar nerve in the hand

Palmar Part of the Ulnar Nerve. — The ulnar nerve divides on the annular ligament or near it, into a superficial and a deep branch, which are distributed to one finger and a half, and to some of the muscles of the hand.

has a deep and

The *deep branch* accompanies the profunda artery to the muscles, and will be subsequently dissected with that vessel.

The *superficial branch* furnishes an offset to the palmaris brevis muscle, and some filaments to the integument of the inner part of the hand, and then ends in two digital nerves for the supply of both sides of the little finger and half the next.

superficial part.

The more internal nerve is undivided, like the corresponding artery. The other is directed to the cleft between the ring and little fingers, where it bifurcates for the supply of their opposed sides. In the palm of the hand this last branch is connected with a digital branch of the median nerve. Along the sides of the fingers the digital branches have the same anatomy as those of the median nerve.

The last ends in two digital nerves for little finger and half next.

Palmar Part of the Median Nerve. — As soon as the median nerve has reached the palm of the hand beneath the annular ligament, it becomes enlarged and somewhat flattened, and is divided into two nearly equal parts. From these divisions the digital nerves to the thumb and to the remaining two fingers and a half are derived. The more external of the two parts furnishes likewise a small muscular branch to the ball of the thumb. The trunk of the nerve and its branches are covered in the hand by the palmar fascia; and they rest on the tendons of the flexor muscles.

Median nerve in the hand supplies muscles and fingers.

The *branch to the muscles of the thumb* supplies the outer half of the short flexor, and ends in the abductor and opponens pollicis muscles.

Branch to the muscles.

The *digital nerves* are five in number: three of them for the sides of the thumb and the radial side of the fore-finger, are undivided, and are furnished by the external division of the trunk of the median; the other two spring from the inner division of that nerve, and are bifurcated to supply the opposed sides of the middle and fore, and the middle and ring fingers.

Digital nerves are five, and supply thumb and two fingers, and a half.

The *first two* nerves belong to the thumb, one being on each side, and the most external communicates with branches of the radial nerve. The *third* is directed to the radial side of the index finger, and gives a branch to the most external lumbrical muscle. The *fourth* furnishes a nerve to the second lumbrical muscle, and divides to supply the contiguous sides of the fore and middle fingers. The *fifth*, like the fourth, is distributed by two branches to the opposed sides of the middle and ring fingers: it receives a branch of junction from the ulnar nerve.

First two, third, fourth, fifth.

On the sides of the fingers the nerves are superficial to the arteries, Termi-

nation on the sides of the fingers. and reach to the last phalanx, where they end in filaments for the pulp of the front of the finger, and for the skin beneath the nail. In their course forwards, the nerves supply chiefly tegumentary branches: one of these is directed backwards by the side of the metacarpal phalanx, and after uniting with the digital nerve on the back of the finger, is continued to the dorsum of the last phalanx.

Dissection of deep tendons. *Dissection.* — Cut through the ulnar artery below the origin of the profunda branch, and having divided also the small superficial volar branch (of the radial), throw forwards the arch to the fingers. Divide next the ulnar and median nerves below the annular ligament, and turn them forwards. Finally, make a longitudinal incision through the centre of the annular ligament, without injuring the small muscles that arise from it, and turn the pieces of the ligament to the sides. The tendons of the flexor muscles can now be followed to their termination, and the sheaths of the fingers may be opened for the purpose of observing their insertion.

Tendons of superficial flexor *Tendons of the flexor sublimis.* — Beneath the annular ligament, the tendons of the flexor sublimis are superficial to those of the deep flexor; and the four tendons are nearly on the same level, instead of being arranged in pairs as in in the hand. the fore-arm. Crossing the palm of the hand, the tendons Insertion. enter the sheaths of the fingers, and are *inserted* by two processes into the margins of the middle phalanx, about the centre. When first entering the digital sheath, the tendon of the flexor sublimis conceals that of the flexor profundus; Are slit for the deep flexor. but near the front of the first phalanx it is slit for the passage of the tendon of the latter muscle.

Dissection. *Dissection.* — Cut through the flexor sublimis muscle above the wrist, and throw its tendons towards the fingers.

Tendons of deep flexor *Tendons of the flexor profundus.*—At the lower border of the annular ligament the tendinous mass of the flexor profundus is divided into four pieces; but in the fore-arm only one tendon (that of the fore-finger) is distinct from the rest. cross the hand From the ligament the four tendons are directed through the hand to the fingers. At the root of the finger each enters the digital sheath with a tendon of the flexor sublimis, and to their insertion. having passed through that tendon, is *inserted* into the base of the last phalanx.

Synovial sac surrounds tendons.

In the hand the tendons of the deep flexor give attachment to the small lumbrical muscles. Beneath the annular ligament the tendons of the deep and superficial flexor are surrounded by a large and loose synovial membrane, which projects upwards into the fore-arm, and downwards to the hand.

Lumbrical muscles are attached to deep flexor and first phalanx. Difference in origin.

The LUMBRICALES MUSCLES are four small fleshy slips that are connected with the tendons of the deep flexor. They *arise* from the outer side of the tendons, near the annular ligament, and keeping on the same side of the tendons are *inserted* into an aponeurotic expansion on the dorsal aspect of the first or carpal phalanx. These muscles are concealed for the most part by the tendons and vessels that have been removed; but they are subcutaneous between the processes of the palmar fascia. The outer two arise from single tendons, but each of the others is connected with two tendons.

Tendon of long flexor of thumb to its insertion.

Tendon of the flexor pollicis longus. — Beneath the annular ligament this tendon is external to those of the flexor profundus; it then turns outwards between the heads of the flexor brevis pollicis, and is *inserted* into the last phalanx of the thumb. A separate synovial membrane surrounds it, and is prolonged into the sheath that binds it to the phalanges.

Dissection of muscles of thumb and little finger.

Dissection. — After dividing the flexor profundus above the wrist, throw it and the lumbricales muscles towards the fingers, but preserve two small nerves that enter the two inner muscles. By the removal of the tendons the deep palmar arch of the radial artery and the interossei muscles come into view. The dissector is next to prepare the small muscles of the ball of the thumb and of the little finger. Some care is necessary in order to make a satisfactory separation of the different small muscles: those of the little finger are most easily dissected.

Four muscles in the ball of the thumb, viz.

Short muscles of the thumb. — These are four in number, and are named from their action on the thumb. The most superficial is the abductor pollicis; and beneath it is the opponens pollicis, which is fixed to the whole length of the metacarpal bone. To the inner side of the last is the short flexor; and the wide muscle coming from the second metacarpal bone is the adductor of the thumb.

Abductor. Attachments. Is the most superficial.

The ABDUCTOR POLLICIS is thin and narrow, and is superficial to the rest. It *arises* from the annular ligament and the os trapezium, and is *inserted* into the base of the first phalanx of the thumb, some fibres also joining the extensor tendon on the dorsum of the bone. The muscle is subcutaneous, and rests on the opponens pollicis.

Dissection.

Dissection.—Cut through the abductor, and the opponens pollicis will be seen. To separate the opponens from the short flexor on the inner side, the student should begin near the farther end of the metacarpal bone, where there is usually a cellular interval.

Opponens is fixed to the metacarpal bone, and is beneath former.

The OPPONENS POLLICIS *arises* from the annular ligament and the os trapezium, and is *inserted* into the whole length of the metacarpal bone of the thumb. This muscle is partly concealed by the preceding, though it is larger and projects on each side. Along its inner border is the flexor brevis pollicis.

Flexor brevis arises by two heads, and is inserted by two heads. It is deep in the hand.

The FLEXOR BREVIS POLLICIS consists of two parts (inner and outer), and is the largest of the short muscles of the thumb. The *outer* part or *head* arises from the annular ligament and the ridge of the os trapezium; whilst the *inner head* arises from the os trapezoides, and from the os magnum and the base of the third metacarpal bone. The heads are soon blended in one mass that is *inserted* by two parts into the sides of the base of the first phalanx of the thumb,—the inner piece being united with the adductor, and the outer with the abductor pollicis. A sesamoid bone is connected with each lateral piece of insertion. The tendon of the long flexor lies on this muscle, occupying the interval between its processes of insertion; and the deep palmar arch comes from beneath it.

Adductor crosses from third metacarpal bone, is by the side of the short flexor, and deep in the hand.

The ADDUCTOR POLLICIS is pointed at the thumb, and wide at the opposite end. Its *origin* is fixed to the lower two thirds of the metacarpal bone of the middle finger, on the anterior aspect; and its *insertion* is attached, with that of the short flexor, to the inner side of the first phalanx of the thumb. The cutaneous surface is in contact with the tendons of the flexor profundus and their lumbrical muscles; and the deep surface lies over (in this position) the abductor indicis in the first interosseous space, and on the second and third metacarpal bones and the intervening muscles.

Short muscles of the little finger. — There are commonly two muscles in the ball of the little finger,—an abductor and an adductor. Sometimes there is a short flexor muscle between the other two.

Two or three muscles to little finger.

The ABDUCTOR MINIMI DIGITI is the most internal of the short muscles. It *arises* from the pisiform bone and the tendon of the flexor carpi ulnaris, and is *inserted* into the base of the first phalanx of the little finger, but an offset is sent to the extensor tendon on the back of the phalanx. The palmaris brevis partly conceals the muscle.

An abductor is the most external.

The FLEXOR BREVIS MINIMI DIGITI appears to be only a part of the abductor. Placed at the radial border of the preceding muscle, it takes *origin* from the unciform bone and the annular ligament, and is *inserted* with the abductor into the first phalanx. It lies on the adductor, and near its origin it is separated from the abductor muscle by the deep branch of both the ulnar artery and nerve.

Flexor brevis is often absent.

Is on the inner side of preceding.

The ADDUCTOR vel OPPONENS DIGITI MINIMI resembles the opponens pollicis in being inserted all the length of the metacarpal bone. Its *origin* is attached to the unciform bone and the annular ligament, and the *insertion* is fixed into the anterior aspect of the metacarpal bone of the little finger. It is partly overlaid by the preceding muscles; and beneath it the deep branches of the ulnar artery and nerve pass.

Opponens is fixed to metacarpal bone.

Is the most internal.

Dissection. — Detach the inner head of the flexor brevis pollicis at its origin, and seek the radial artery which here enters the palm of the hand between the first two metacarpal bones. Clean the deep palmar arch, and dissect out at the same time the offsets of the deep branch of the ulnar nerve. A fascia which covers the interossei muscles is to be removed after the dissector has observed its connection with the transverse ligament that unites the heads of the metacarpal bones.

Dissection of deep arch and inter-ossei muscles.

RADIAL ARTERY IN THE HAND. — The radial artery enters the palm of the hand at the first interosseous space, between the heads of the abductor indicis muscle; and after furnishing one branch to the thumb and another to the index finger, turns across the hand towards its ulnar side, thus forming the deep palmar arch.

Radial artery in hand.

Forms deep arch which lies near carpal bones

The *deep palmar arch* extends from the first interosseous space to the base of the metacarpal bone of the little finger, where it joins the communicating (profunda) branch of the ulnar artery. In its course across the hand, the radial artery forms the arch, whose convexity is directed forwards, and whose position is nearer the carpal bones, and more posterior than that of the superficial arch. Having a deep position in the hand, the arch lies on the metacarpal bones and the interossei muscles; but is covered by the long flexor tendons, and in part by the inner head of the flexor brevis pollicis. The *branches* of the deep palmar arch are the following: —

and beneath all muscles. Branches of the arch.

Recurrent. *a. Recurrent branches* pass from the concavity of the arch to the front of the carpus, supplying the bones, and anastomosing with the other carpal arteries. Perforating. *b.* Three *perforating arteries* pierce the interossei muscles to anastomose with the interosseous arteries on the back of the hand. Interosseous. *c.* Usually there are three *palmar interosseous arteries*, which occupy the three inner spaces between the metacarpal bones, and terminate by joining the digital branches of the superficial palmar arch at the clefts of the fingers: these branches supply the interosseous muscles,-and vary much in their size and distribution.

Other branches of radial.

Branches of the radial artery. — As soon as the radial artery enters the hand, it gives off the large artery of the thumb, and the digital branch of the index finger.

Digital artery of the thumb.

The *large artery of the thumb* (art. princeps pollicis) runs along the metacarpal bone of the thumb between the abductor indicis and the flexor brevis pollicis, to reach the interval between the processes of insertion of the last muscle. Here the artery divides into the two collateral digital branches of the thumb, which unite in an arch on the last phalanx, as in the fingers. The distribution of these is the same as that of the arteries of the superficial arch.

Digital artery of the fore-finger.

The *digital branch of the index finger* (art. radialis indicis) is directed over the abductor indicis, and beneath the short flexor and the adductor pollicis to the radial side of the fore-finger. At the lower border of the abductor indicis this branch is connected by an offset with the superficial arch; and at the end of the finger it unites with the digital branch furnished to the opposite side by the ulnar artery.

The *deep branch of the ulnar nerve* in the hand accompanies the deep palmar arch of the radial artery as far as the muscles of the thumb, and terminates in branches to the adductor pollicis, the inner head of the short flexor, and the abductor indicis. Deep branch of ulnar nerve.

Branches. — Near its origin the nerve furnishes branches to the muscles of the little finger. In the palm it gives a branch to each palmar and dorsal interosseous muscle of the three inner spaces; and the branches of the inner two palmar interossei supply twigs to the inner two lumbrical muscles. Muscular offsets.

The *transverse metacarpal ligament* connects together the heads of the metacarpal bones. Its cutaneous surface is hollowed where the flexor tendons cross it; and beneath it the interossei muscles pass to their insertion. To the posterior border is united the fascia that covers the interossei muscles. This ligament should be taken away to see the interossei muscles. Ligament of heads of metacarpal bones.

The INTEROSSEI MUSCLES are so named from their position between the metacarpal bones, and are seven in number. Two muscles occupy each space, except the first, in which there is only one, and they are inserted into the first phalanx of each finger. All these small muscles are evident in the palm of the hand, but some project more than the others, giving rise to the distinction of palmar and dorsal interossei. Seven interossei muscles, divided into palmar and dorsal.

The *palmar* muscles are three in number, and are smaller than the dorsal set, although they project most into the palm. Undivided at the posterior part, they *arise* from the palmar surface of the metacarpal bones of the fingers on which they act, viz. those of the fore, ring, and little fingers. The *dorsal* interossei extend farther back than the palmar set, and *arise* by a double head from the lateral surfaces of the two metacarpal bones, between which they lie. The dorsal muscles are thus allotted to the fingers: two belong to the middle finger, one to the fore, and one to the ring finger. The first muscle of this set is noticed separately below, under the name abductor indicis. Number and origin of palmar and dorsal sets.

Both sets of muscles have a similar termination. Thus the fibres end in a tendon which is *inserted* into the side of the first or carpal phalanx, and sends an expansion to join the aponeurotic covering of that phalanx. But the side of the phalanx to which Common insertion of both sets.

Special insertion of each muscle. each muscle is directed, will be remembered by a reference to its action. Thus the palmar set draw towards the middle finger the other three fingers, and are so attached as to produce that result. But the dorsal set abduct the fore and ring fingers from the middle finger; and the two muscles that are connected with the middle finger will carry this to the right and left of a line passing through its centre.

First dorsal interosseous is a large distinct muscle perforated by radial artery. The *abductor indicis*, or the first dorsal interosseous muscle, *arises* from the whole of the metacarpal bone of the index finger, and from half that of the thumb; and is *inserted* into the radial side of the first phalanx of the fore-finger. By the palmar surface the muscle is in contact with the adductor and flexor brevis pollicis; and by the opposite surface it is subcutaneous. The radial artery perforates it to enter the palm.

Dissection. *Dissection.*—Take away the small muscles of the thumb and little finger from the annular ligament, and trace the attachments of the ligament to the carpal bones on each side. Afterwards put together the ends of the cut ligament.

Annular ligament of front of wrist. The *anterior annular ligament* is a firm ligamentous band that arches over the flexor tendons of the fingers. It is attached externally to the front of the os scaphoides and the ridge of the os trapezium, and internally to the unciform and pisiform bones. By its upper border it is connected with the aponeurosis of the fore-arm, and by its lower border with the palmar fascia. On the cutaneous surface lie the palmaris longus and the ulnar artery and nerve.

Dissection. *Dissection.*—Next follow the tendon of the flexor carpi radialis to its insertion, and dissect out more fully the attachment of the biceps and brachialis anticus muscles to the bones of the fore-arm.

Insertion of tendon of flexor carpi radialis. The *tendon of the flexor carpi radialis*, in passing from the fore-arm to the hand, lies in the groove in the os trapezium, between the attachments of the annular ligament. Here it is bound down by a fibrous sheath, which continues to its *insertion* into the base of the metacarpal bone of the index finger.

Insertion of brachialis anticus. The *insertion of the brachialis anticus* takes place by a broad, thick tendon into the anterior part of the coronoid

process of the ulna. If the muscle is cut across, its origin from the articulation of the elbow will come into view.

Insertion of the biceps.—The tendon of the biceps is inserted behind the tubercle of the radius, and a bursa is found between it and the bone. Near its attachment the tendon changes the direction of its surfaces; the anterior surface becoming external, and *vice versâ*. The supinator brevis muscle partly surrounds the insertion. Insertion of the biceps tendon.

Section VI.

THE BACK OF THE FORE-ARM.

Dissection.—Turn over the limb, and place a small block beneath the wrist. Remove the fascia and the cutaneous nerves and vessels from the muscles of the fore-arm, and from the tendons on the back of the hand; but leave untouched a thickened band of fascia (posterior annular ligament) opposite the carpus. If the integument has not been taken from the fingers, let the dissector proceed to remove it, in order that the tendons may be traced to the ends of the fingers. The several muscles should be separated from one another at their origin, especially the radial extensors of the wrist. Take away the superficial vessels and the fascia.

The *posterior annular ligament* consists of the aponeurosis of the fore-arm, which is thickened by the addition of some transverse fibres opposite the lower ends of the bones of the fore-arm. This ligamentous band is connected at the outer part to the radius, and at the inner to the pisiform bone. It confines the extensor tendons, and sends downwards processes which are fixed to the bones, forming sheaths for those tendons. Annular ligament behind the wrist.

Muscles of the back of the fore-arm.—Here the muscles are arranged in a superficial and deep layer, like those of the front of the fore-arm. Two layers of muscles. The superficial layer is composed of seven muscles, which arise mostly by a common tendon from the outer condyle of the humerus, and have the undermentioned position one to another. Superficial has seven muscles, viz. Proceeding from without inwards, the student will find successively the long supinator, two radial extensors of the wrist (long and short),

the common extensor of the fingers, the extensor of the little finger, and lastly the ulnar extensor of the wrist. One other small muscle near the elbow is the anconeus.

Supinator longus arises from humerus

The SUPINATOR RADII LONGUS is contained partly in the arm and partly in the fore-arm, and limits on the outer side the hollow in front of the elbow. The muscle *arises* from the outer part of the humerus along two thirds of the line leading to the outer condyle, and from the front of the external intermuscular septum. The fleshy fibres end in a tendon above the middle of the fore-arm, by means of which the muscle is *inserted* into the base of the styloid process of the radius. In the arm the margins of the supinator are directed forwards and backwards, but in the fore-arm the muscle is flattened over the others, and its edges have an opposite direction. Near its insertion the supinator is crossed by two extensors of the thumb. Along its inner border, below the elbow, is the radial artery; and above the joint it is in contact with the brachialis anticus. Beneath this muscle are found the extensors of the wrist, the radial nerve, and the radius.

and is inserted into radius.

Is superficial, and forms part of hollow in front of the elbow.

Extensor carpi longus is nearly as long as the preceding.

The EXTENSOR CARPI RADIALIS LONGIOR arises from the lower third of the outer condyloid ridge of the humerus, and from the front of the contiguous intermuscular septum. The muscle descends on the short radial extensor; and its tendon passes beneath the extensors of the thumb, and through the annular ligament, to be *inserted* into the base of the metacarpal bone of the index finger. Along its outer border is the radial nerve.

Insertion.

Extensor carpi brevis is contained in the fore-arm.

The EXTENSOR CARPI RADIALIS BREVIOR arises from the outer condyle of the humerus by a tendon common to it and the three following muscles, viz. the common extensor of the fingers, the extensor of the little finger, and the ulnar extensor of the wrist: it also takes origin from aponeuroses on its under and inner sides. The tendon of the muscle is closely connected with the preceding, and after passing with it through the same compartment of the annular ligament, is *inserted* into the base of the metacarpal bone of the middle finger. Concealed by the two preceding muscles, this extensor rests on the radius and on some of

Insertion into metacarpal bone.

the muscles attached to it; that is to say, on the supinator brevis, the pronator teres, and the extensor ossis metacarpi pollicis. Along the inner side is the common extensor of the fingers, and the extensors of the thumb come between the two.

Has a common origin with three following.

The EXTENSOR COMMUNIS DIGITORUM is single at its origin, but is divided inferiorly into four tendons. It *arises* from the common tendon, from aponeurotic septa between it and the muscles around, and from the aponeurosis of the fore-arm. Near the lower part of the fore-arm the muscle ends in three tendons, which pass through a compartment of the annular ligament with the indicator muscle. Escaping from the ligament, the most internal tendon divides into two, and all four are directed along the back of the hand to their insertion into the two last phalanges of the fingers.

Common extensor muscle.

Origin in the fore-arm.

On the back of the fingers the tendons have the following disposition: — Opposite the metacarpo-phalangeal articulation each tendon sends down lateral bands to join the capsule; and on the dorsum of the first phalanx it forms an expansion with the tendons of the lumbricales and interossei muscles. At the anterior part of the first phalanx this tendinous expansion is divided into three parts: the central one is fixed into the base of the second phalanx, whilst the lateral pieces unite at the front of the second phalanx, and are inserted into the last. On the fore and little fingers the expansion is joined by their special tendons.

Insertion of the tendons into the phalanges.

This muscle is placed between the extensors of the wrist and little finger, and conceals the deep extensors. The tendon of the ring finger is united by an oblique band with each collateral tendon, so as to prevent the raising of that finger if the other fingers are closed.

Connections of the muscle.

The EXTENSOR MINIMI DIGITI is the most slender muscle on the back of the fore-arm, and appears to be but a part of the common extensor. Its *origin* is in common with that of the extensor communis, but it passes through a distinct sheath of the annular ligament; and its tendon, which is split into two directly afterwards, ends by joining the common tendinous expansion on the first phalanx of the little finger.

Extensor of little finger.

Common origin

and termination.

The EXTENSOR CARPI ULNARIS MUSCLE arises from the

Exten-

sor carpi ulnaris. Origin. common tendon, from the posterior border of the ulna below the anconeus muscle (about the middle third), and from the aponeurosis of the fore-arm. The tendon of the muscle becomes free from fleshy fibres near the annular ligament, and passes through a separate sheath in that structure to be *inserted* into the base of the metacarpal bone of the little finger. Beneath this extensor is the deep layer of muscles with part of the ulna. On the outer side is the extensor of the little finger.

Inser-tion. Is the most internal muscle.

Anconeus has a distinct origin and insertion; is close to the triceps.

The ANCONEUS is a small triangular muscle near the elbow joint, which *arises* from the outer condyle of the humerus by a tendon distinct from and posterior to the common tendon of origin of the other muscles. From this origin the fibres diverge to their *insertion* into the olecranon, and into the impression near it on the posterior surface of the ulna. The upper fibres are contiguous to the lowest of the triceps muscle; and beneath the anconeus are the supinator brevis muscle and the recurrent interosseous vessels.

Dissection of deep layer of muscles and interosseous vessels and nerve.

Dissection. — Detach the extensor communis, extensor minimi digiti, and extensor carpi ulnaris from their origin, and turn them aside. Small branches of the posterior interosseous nerve and artery, which will be seen entering the muscles, may be divided. Take away the cellular membrane from the muscles and from the ramifications of the posterior interosseous artery and nerve. A slender part of the nerve, that sinks beneath one muscle (extensor of the second phalanx of the thumb), about the middle of the fore-arm, should be taken care of. The separation between the small muscles of the thumb, especially between the two highest, is not always very distinct.

Five muscles in the deep layer, viz.

Deep layer of muscles. — In this layer there are five small muscles, viz. one supinator of the fore-arm and four special extensor muscles of the thumb and fore-finger. The highest muscle, that partly surrounds the upper end of the radius, is the supinator brevis. Below this are three extensors of the thumb in the following order—one of the metacarpal bone, one of the first, and one of the second phalanx. On the ulna the indicator muscle is placed.

Extensor metacarpi pollicis

The EXTENSOR OSSIS METACARPI POLLICIS is the largest of the extensor muscles of the thumb, and is sometimes united

with the supinator brevis. It *arises* from the posterior surfaces of the radius and ulna, for about three inches below the supinator, and from the intervening interosseous membrane. The tendon of the muscle is directed outwards over the radial extensors of the wrist, and through the outer compartment in the annular ligament, to be *inserted* into the base of the metacarpal bone of the thumb. The muscle is at first concealed by the common extensor of the fingers; but it becomes cutaneous between the last muscle and the extensors of the wrist, about two inches above the end of the radius. Opposite the carpus the radial artery winds backwards beneath its tendon. Between the contiguous borders of this muscle and the supinator brevis, the posterior interosseous artery appears.

has a wide attachment.

Insertion.

The muscle is at first deep, but afterwards superficial.

The EXTENSOR PRIMI INTERNODII POLLICIS is the smallest muscle of the deep layer, and its tendon is closely connected with that of the preceding extensor. Its *origin* is about an inch in extent on the radius and the interosseous membrane, close below the attachment of the preceding muscle. Its fibres end in a tendon which passes with the extensor of the metacarpal bone through the same space in the annular ligament, and is *inserted* into the carpal end of the first phalanx of the thumb. With respect to surrounding parts, this muscle has the same connections as the previous one.

Extensor of first phalanx of thumb has a small origin, and lies with preceding.

Insertion into the thumb.

The EXTENSOR SECUNDI INTERNODII POLLICIS arises from the ulna, its middle third, and from the interosseous membrane. Its tendon of insertion, after passing through a sheath in the annular ligament distinct from that of the other two extensor muscles, is directed along the dorsum of the thumb to be fixed to the base of the last phalanx. It is covered by the same muscles as the other two extensors of the thumb, but it becomes superficial nearer the lower end of the radius. Below the annular ligament its tendon crosses the radial artery, and the tendons of the extensors of the wrist.

Extensor of second phalanx lies alone in the annular ligament.

Insertion.

Is lower than the preceding two.

The EXTENSOR INDICIS (indicator muscle) arises from the middle part of the ulna, and slightly from the lower part of the interosseous membrane. Near the annular ligament the tendon becomes free from muscular fibres, and passing

Indicator muscle.

Origin.

It is ap-

plied to common extensor, and inserted with it. through the ligament with the common extensor of the fingers, is applied to the external tendon of that muscle, and becomes blended with it in the expansion on the first phalanx of the fore-finger. Until this muscle has passed the ligament it is covered by the superficial layer, but afterwards it is subfascial.

Dissection of supinator brevis. *Dissection.*— For the complete display of the supinator brevis, it will be necessary to detach the anconeus from the external condyle of the humerus, and to cut through the supinator longus and the radial extensors of the wrist. Afterwards, the student is to follow forwards its fibres to their insertion into the radius, and to remove that part of the origin of the flexor profundus digitorum, which lies on the outer side of the insertion of the brachialis anticus.

Origin of short supinator; The SUPINATOR BREVIS arises from the orbicular ligament of the radius and from the external lateral ligament of the elbow joint; from a depression below the small sigmoid cavity of the ulna, and from the external margin of the last bone for about two inches. From this origin the fibres pass outwards, and are *inserted* into the upper third of the radius, as far forwards as the tubercle and the oblique line on it. This supinator is altogether concealed at the posterior and external aspects of the limb by the muscles of the superficial layer, and anteriorly the radial artery and nerve lie over it. The lower border is contiguous to the extensor ossis metacarpi pollicis, only the posterior interosseous artery intervening. Through the substance of the muscle the posterior interosseous nerve winds to the back of the limb.

and insertion into the radius. Overlying and contiguous parts.

Posterior interosseous artery is between the two layers of muscles. The *posterior interosseous artery* is an offset from the common interosseous artery (p. 265.), and reaches the back of the fore-arm above the interosseous ligament. Passing between the contiguous borders of the supinator brevis and extensor ossis metacarpi, the artery descends between the superficial and deep layer of muscles nearly to the wrist, where it ends by anastomosing with the carpal and anterior interosseous arteries. It furnishes many *muscular* offsets, and the following recurrent branch:—

The *recurrent branch* springs from the artery near its commencement, and ascends through some fibres of the supinator, but beneath the anconeus, to supply the elbow joint, and to anastomose with a long branch of the superior profunda artery in the last named muscle. Its recurrent branch.

The *posterior interosseous nerve* takes its origin from the musculo-spiral trunk in front of the outer condyle of the humerus, and winds backwards through the fibres of the supinator brevis. Escaped from the supinator, the nerve is placed between the superficial and deep layers of the muscles as far as the middle of the fore-arm. Much reduced in size at this spot, it sinks beneath the extensor of the second phalanx of the thumb, and runs on the interosseous membrane to the back of the carpus. Finally, the nerve enlarges beneath the tendons of the extensor communis digitorum, and terminates in filaments to the ligaments and the articulations of the carpus. Interosseous nerve. Position to muscles. Termination on back of the carpus.

Muscular branches. — This nerve furnishes branches to all the muscles of the deep layer; and to those of the superficial layer, except the anconeus, the supinator longus, and the extensor carpi radialis longior. Its muscular offsets.

Radial Artery at the Wrist. — At the wrist the radial artery winds below the end of the radius to the back of the carpus, and enters the palm of the hand at the first interosseous space, between the heads of origin of the first dorsal interosseous muscle. At first the vessel lies deeply on the external lateral ligament of the wrist joint, and is beneath the extensor tendons of the metacarpal bone and first phalanx of the thumb; but afterwards it is more superficial, and is crossed by the tendon of the extensor of the second phalanx of the thumb. Offsets of the external cutaneous nerve twine around the artery. Its *branches* are numerous, but inconsiderable in size. Radial artery on back of wrist. Connections with parts around. Branches are small.

a. The *dorsal carpal branch* passes transversely beneath the extensor tendons, and forms an arch with the corresponding offset of the ulnar artery. From this arch branches descend to the third and fourth interosseous spaces, constituting the *dorsal interosseous arteries.* To back of carpus.

Meta-carpal branch. *b.* The *metacarpal* or *first dorsal interosseous branch* reaches the space between the second and third metacarpal bones, and anastomoses, like the corresponding arteries of the other spaces, with a perforating branch of the deep palmar arch. Finally, it is continued to the cleft of the fingers, where it ends by joining the digital artery of the superficial palmar arch, and giving small dorsal branches to the index and middle fingers.

Dorsal arteries of the thumb *c.* Two small *dorsal arteries of the thumb* arise opposite the metacarpal bone of the thumb, along which they extend, one on each border, to be distributed on its posterior aspect.

and fore-finger. *d.* The *dorsal branch of the index finger* is distributed on the radial edge of the metacarpal bone of the finger.

Sheaths of the annular ligament are six. The different compartments of the annular ligament may now be more completely examined by dividing the sheaths of the ligament over the different tendons passing beneath. There are six different spaces, which are lubricated by Position from without inwards. synovial membranes. The most external one lodges the two first extensors of the thumb; the next is a large hollow for the two radial extensors of the wrist; and a very small space for the extensor of the second phalanx of the thumb follows on the ulnar side. Still to the inner side is the common sheath for the extensor of the fingers and that of the fore-finger; but there is a separate internal compartment for the extensor of the little finger. And internal to all is Bones grooved by the tendons. the space for the extensor carpi ulnaris. The last muscle grooves the ulna, but all the others lie in hollows in the radius in the order mentioned above.

To see supinator brevis, *Dissection.*—If the supinator brevis is divided by a vertical incision, and raised from the radius, its attachment will be better seen.

interosseous nerve, Cut through the tendons of the extensor of the fingers and indicator muscle at the wrist, and follow the posterior interosseous nerve, as well as the offsets from its gangliform enlargement.

and interossei muscles. Clean also the dorsal aspect of the posterior interossei muscles of the hand, and observe their double origin, and their central tendon of insertion into the side, and on the dorsum of the phalanges. The posterior perforating arteries appear between the heads of origin of these muscles.

Section VII.

LIGAMENTS OF THE ELBOW, WRIST, AND HAND.

For the examination of the remaining articulations of the limb, the student should moisten the ligaments that have become dry.

Dissection. — To make the necessary dissection of the ligaments of the elbow joint, take away the brachialis anticus from the front of the joint, and the triceps from the back of it; detach also the muscles from the outer and inner condyles, as well as the supinator brevis and flexor profundus. By means of a little cleaning, the four ligaments — anterior, posterior, and two lateral — will come into view. Afterwards the muscles may be removed from the interosseous membrane of the fore-arm, both on the anterior and posterior aspects.

Dissection of the elbow joint.

The Elbow Joint. — In this articulation the lower end of the humerus is received into the hollow of the ulna, so as to constitute a hinge-joint; and the upper end of the radius likewise forms a part of the joint. Where the bones touch, the surfaces are covered with cartilage, and their articular ends are kept in place by the following ligaments: —

Bones forming the elbow joint.

The ligaments are

The *external lateral ligament* is a roundish fasciculus, which is attached by its upper end to the outer condyle of the humerus, and by its lower end to the orbicular ligament around the head of the radius. A few of the posterior fibres pass backwards to the upper part of the external margin of the ulna.

External lateral.

The *internal lateral ligament* is triangular in shape: it is pointed at its upper end, and is connected to the inner condyle of the humerus. The fibres diverge as they descend, and are inserted thus: — The anterior ones, which are the strongest, are fixed to the inner edge of the coronoid process; the posterior are attached to the inner side of the olecranon; whilst the middle fibres join a transverse ligamentous band between the olecranon and the coronoid process. The ulnar nerve is in contact with this ligament;

Internal lateral is wide.

Inferior attachments.

A notch

on inner side of the joint. and some vessels enter the joint by an aperture beneath the transverse band.

Anterior ligament is thin. The *anterior ligament* is very thin, and its fibres are separated by intervals containing fat. By its upper margin the ligament is inserted into the front of the humerus, and by its lower margin into the anterior part of the coronoid process and the orbicular ligament. The brachialis anticus muscle arises from the ligament, and conceals it.

Posterior ligament is weakest. The *posterior ligament* is thinner than the anterior, and is completely covered by the triceps muscle. Superiorly it is attached to the humerus above the fossa for the olecranon, and inferiorly it is inserted into the olecranon. Some fibres are transverse between the margins of the fossa before mentioned.

Dissection. *Dissection.*—Open the joint by an incision across the front, near the humerus, and disarticulate the bones, in order that the synovial membrane, and the form of the articular surfaces, may be seen.

Synovial membrane. The *synovial membrane* covers the articular ends of the bones, and can be traced from one to another along the inner surface of the connecting ligaments. It projects between the head of the radius and the orbicular ligament, and between the head of that bone and the small sigmoid cavity.

Lower end of the humerus. One surface for radius. *Articular surfaces of the bones.*—The humerus presents inferiorly two distinct articular surfaces for the bones of the fore-arm. The one for the radius is on the outer side, and consists of a rounded eminence on the front of the bone, which is covered with cartilage only on the anterior aspect: between it and the surface that corresponds to the ulna is a slight hollow. The surface in contact with the ulna is limited internally and externally by a prominent ridge, and is hollowed out in the centre like a pulley (trochlea): the external ridge corresponds to the interval between the heads of the radius and ulna. On the front of the humerus, above the articular surface, is a depression that receives the coronoid process during flexure of the joint; and on the posterior aspect is a large fossa for the reception of the olecranon in extension of the fore-arm.

another for the ulna; also for coronoid process, and olecranon.

On the end of the ulna there is a large excavation (sigmoid cavity), which is narrow in the centre, but expanded in front and behind. A slightly raised line extends from front to back across the cavity, and is received into the hollow of the trochlea of the humerus. End of the ulna.

The end of the radius presents a circular depression, with a raised margin; and when it touches the humerus during the bent state of the joint, the hollow receives the eminence, and the rim fits into the depression of that bone. End of the radius.

UNION OF THE RADIUS AND ULNA. — The radius is connected with the ulna, both at the upper and lower ends, by means of distinct ligaments and a synovial membrane; and the shafts of the bones are also united by an interosseous ligament. Radius is joined to ulna.

Upper radio-ulnar articulation. — Here the head of the radius is received into the small sigmoid cavity of the ulna, and is kept in place by the following ligamentous band. At the upper end by

The *annular* or *orbicular ligament* is a strong fasciculus of fibres, about a quarter of an inch wide, which is placed over the prominence of the head of the radius, and is attached to the anterior and posterior edges of the small sigmoid cavity of the ulna. Its upper border is connected with the ligaments of the elbow joint, and the lower is applied to the neck of the radius. The radius moves freely in the socket formed by the ligament and the cavity of the ulna. orbicular ligament around the head of the bone,

The *synovial membrane* is but a prolongation of that lining the elbow joint; it projects between the neck of the radius and the lower margin of the annular ligament. and synovial membrane.

The *interosseous membrane* is a thin aponeurotic layer, which is attached to the contiguous margins of the radius and ulna, so as to form a septum between the muscles on the front and back of the fore-arm. Superiorly the membrane is wanting for a short space, and through the interval the posterior interosseous vessels pass backwards. Some small apertures exist in it for the passage of vessels; and the largest of these is about two inches from the lower margin, through which the anterior interosseous artery turns to the back of the wrist. The membrane gives attachment to the Radius is joined in the middle by interosseous membrane. This is deficient above.

deep muscles. Most of its fibres are directed obliquely inwards towards the ulna, though a few on the posterior surface have an opposite direction.

by round ligament. The *round ligament* is a slender band above the interosseous membrane, whose fibres have a direction opposite to those of the membrane. By one end it is fixed to the front of the coronoid process, and by the other it is inserted into the radius below the tubercle. This ligament divides the space above the interosseous membrane into two parts.

The lower end after. The lower radio-ulnar articulation cannot be seen till after the examination of the wrist joint.

Dissection. *Dissection.*—To see the ligaments of the wrist joint, remove the tendons and the annular ligament from both its front and back. Then clean away carefully the cellular membrane and the small vessels from the surface of the ligaments.

Bones forming wrist THE WRIST JOINT. — The lower end of the radius and the first row of the carpal bones enter into the wrist joint; and four ligaments maintain the bones in contact, viz. anterior and posterior, and two lateral. The ulna is shut out from this articulation by means of a piece of cartilage. (united by)

external lateral, The *external lateral ligament* is a short band that intervenes between the styloid process of the radius and the upper part of the scaphoid bone.

internal lateral, The *internal lateral ligament* is smaller than the external, but is longer than it. It is attached by one end to the styloid process of the ulna, and by the other to the rough, upper part of the cuneiform bone. Some of the anterior fibres are continued to the pisiform bone.

anterior and The *anterior ligament* takes origin from the ends of the radius and ulna, and is inserted into the anterior aspect of the first row of carpal bones, except the os pisiforme.

posterior ligament. The *posterior ligament* is membranous, like the anterior, and its fibres are directed downwards and inwards. Superiorly it is attached to the lower ends of the radius and ulna, and inferiorly it is fixed after the manner of the anterior ligament, to the first row of carpal bones, on their posterior aspect.

Dissection. — Open the articulation by a transverse incision through the posterior ligament near the bones of the carpus. Dissection.

Articular surfaces.—The end of the radius and the fibro-cartilage uniting it with the ulna form an arch for the reception of the carpal bones; and the surface of the radius is divided by a prominent line into an external triangular, and an internal square impression. The three bones of the first carpal row constitute a convex eminence, which is received into the hollow before mentioned; the scaphoid bone corresponding to the external mark of the radius, the semilunar bone to its square impression, and the cuneiform bone touching the triangular fibro-cartilage. Surface of radius. Of first row of carpal bones.

The *synovial membrane* covers the surface of the radius and the fibro-cartilage, and is reflected along the ligaments to the bones of the carpus. This membrane sometimes joins that lining the lower radio-ulnar articulation, by means of an aperture in the fibro-cartilage separating the two. Synovial sac.

Lower Radio-ulnar Articulation. — In this articulation the convexity of the end of the ulna is received into a concavity on the radius; an arrangement just the opposite to that which exists between the upper ends of the bones. The chief bond of union between the bones is a strong fibro-cartilage; but a kind of capsule, consisting of scattered fibres, surrounds loosely the end of the ulna. Lower ends of radius and ulna joined by capsule.

The *triangular fibro-cartilage* is placed transversely beneath the end of the ulna, and is thickest at its margins and apex. By its base the cartilage is fixed to the ridge which separates the carpal from the ulnar articulating surface of the radius; and by its apex, to the depression at the root of the styloid process of the ulna. Its margins are united with the contiguous anterior and posterior ligaments of the wrist joint; and its surfaces are covered by two distinct synovial membranes, viz. those of the wrist and lower radio-ulnar articulation. Occasionally it is perforated by an aperture. Triangular fibro-cartilage. Attachments and connections.

The *synovial membrane* (membrana sacciformis) covers Synovia

membrane. the upper surface of the triangular cartilage, and the part of the ulna in contact with it, and ascends between the radius and the ulna, covering their articular surfaces. This membrane is very loose, from which circumstance it has received its name.

Dissection. *Dissection.* — To see the articulations of the carpal bones, take away all the tendons from the hand, and clean carefully the surface of the connecting ligamentous bands. To the pisiform bone there are distinct ligaments. At the same time, the ligamentous bands uniting the metacarpal with the carpal bones, and with one another, should be dissected.

Bones are joined into two rows. UNION OF THE CARPAL BONES.—The several bones of the carpus are united into two rows by dorsal, palmar, and interosseous bands; and the two rows are connected together by separate ligaments.

How first row is formed. *Bones of the first row.* — The os semilunare is united to the contiguous bones, viz. the scaphoid and cuneiform, by a *dorsal* and a *palmar* transverse band, as well as by a strong *interosseous* ligament to each. Separate ligaments of pisiform bone. The pisiform bone is articulated to the front of the unciform bone by a distinct *capsule* and a *synovial* membrane; and it has further two special ligaments,—one being attached to the process of the unciform bone, and the other to the base of the fifth metacarpal bone.

Second row is like first. The *bones of the second row* are connected together in the same way as those of the first row, viz. by a *dorsal* and a *palmar* band of fibres from one bone to another. Between the os magnum and the bone on each side (unciform and trapezoid) is an *interosseous* ligament.

The two rows are joined by *One row with another.* — The two rows of carpal bones are connected by an anterior and posterior, and two lateral ligaments.

anterior, The *anterior* ligament consists of irregular fibres, and intervenes between the two rows on the palmar aspect. The posterior, *posterior* ligament, which is stronger, and the greater number of whose fibres are transverse, has a corresponding and attachment on the dorsal aspect of the bones. Of the *lateral*

ligaments, the external is the strongest, and extends between the os trapezium and the scaphoid bone, whilst the internal ligament passes between the cuneiform and unciform bones.
lateral ligaments.

Dissection.—Divide the lateral and posterior ligaments, and separate one row of bones from another, to see the articular surfaces.
Dissection.

Articular surfaces.—The first row of carpal bones forms an arch, whose hollow is turned towards the other row. In the second row, the bones present a condyloid projection, which is received into the arch before mentioned.
Surface of each row in contact.

One *synovial membrane* serves for the articular surfaces of all the carpal bones, except that of the pisiform, with the unciform bone. Lining the articular surfaces of the joint between the two rows of carpal bones, the membrane sends upwards and downwards prolongations between the individual bones. The offsets upwards are two, and sometimes they open into the synovial membrane of the wrist joint; but the offsets in the opposite direction are three, and are continued to the articulations between the four inner metacarpal and the carpal bones.
One synovial membrane for all the carpal bones, and four inner metacarpal.

Union of the Metacarpal Bones.—The metacarpal bones of the four fingers are connected at their bases by the following ligaments:—Superficial *dorsal* and *palmar* fasciculi of fibres pass from one bone to that next it; and those in the palm are the strongest. Besides, there are short *interosseous* bands between the contiguous rough surfaces of the bones.
Metacarpal bones are joined by their bases

At their anterior extremities the metacarpal bones are bound together by the *transverse ligament*, which has been examined in the dissection of the hand (p. 279.).
and by their heads.

Union between the Metacarpal and Carpal Bones. —The metacarpal bones of the fingers are articulated with the carpal bones after one plan, and have a common synovial membrane; but that of the thumb has a separate capsule and synovial membrane.
Joint between carpal and metacarpal bones;

a. The *metacarpal bone of the thumb* articulates with the os trapezium, and the ends of the bones are encased in a
that of the thumb;

separate articular ligament. The joint is supplied with a *synovial* membrane, which is simple in its arrangement.

those of other fingers · *b.* The *metacarpal bones of the fingers* receive longitudinal bands from the carpal bones on both aspects, thus: —

through dorsal The *dorsal ligaments* are two to each of the four metacarpal bones, except that of the little finger. The bands to the metacarpal bone of the fore finger come from the os trapezium and os trapezoides; those to the third bone are from the os magnum and os trapezoides; those to the bone of the ring finger from the os magnum and os unciforme; and to the fifth metacarpal bone there is but one band from the unciform bone. The *palmar ligaments* are weaker than the dorsal, and do not exist on the metacarpal bones of the fore and little finger. To the metacarpal bone of the middle finger there are two bands—one from the os magnum and the other from the os unciforme; and to that of the ring finger only one ligament passes from the unciform bone. On the inner side of the metacarpal bone of the ring finger is an *interosseous* or lateral band, which comes from the os magnum and os unciforme.

and palmar bands.

Dissection. *Dissection.* — Open the articulation between the metacarpus and carpus on the posterior aspect of the hand, to see the articulating surfaces of the bones.

Surface of the ends of the bones. *Articular surfaces.* — The metacarpal bone of the fore-finger presents a hollowed articular surface, which receives the prominence of the os trapezoides, and articulates laterally with the os trapezium and os magnum. That of the middle finger articulates with the os magnum. But the metacarpal bones of the ring and little finger are opposed to the unciform bone, and do not reach so far back as the other two.

Interosseous ligaments of carpal and metacarpal bones On forcibly separating the carpal bones from one another, their strong interosseous ligaments will appear, viz. one on each side of the os semilunare in the first row, and on each side of the os magnum in the second row. The interosseous ligaments between the bases of the metacarpal bones may likewise be exposed by detaching one from another. Where the metacarpal bones touch they are covered by articular

cartilage, and the surfaces are lined by prolongations of the same synovial membrane, that serves for their articulation with the carpus.

Dissection.—Remove, now, the tendons and the tendinous expansion from the joint between the head of the metacarpal bone and the first phalanx of the finger. A lateral ligament on each side, and an inferior thick band will be readily exposed. Another joint may be opened to see the articular surfaces. The same dissection may be made for the articulations between the phalanges of the finger. Dissection.

UNION BETWEEN THE METACARPAL BONES AND THE FIRST PHALANGES.—In these joints the convex head of the metacarpal bone is received into the glenoid fossa of the phalanx, and the two are retained in contact by the extensor and flexor tendons, and by the following ligaments:— Metacarpal bones and phalanges.

The *lateral ligaments* are the same on both sides of the joint. Each is triangular in form, and is attached by its upper part to the tubercle on the side of the head of the metacarpal bone, but it ends below by being inserted into the side of the phalanx, and into the inferior ligament. The *inferior ligament* is a longitudinal band, which is fixed firmly to the phalanx, but loosely to the metacarpal bone. It is almost cartilaginous in consistence, and is grooved for the flexor tendon: to its sides are attached the lateral ligaments. Covering the upper part of the joint is the extensor tendon, which serves as a superior ligament, and sends down an expansion on each side of the joint. The *synovial* membrane is a simple shut sac, which lines the interior of the joint. Lateral ligaments. Inferior ligament. Synovial membrane.

In the articulation of the thumb two sesamoid bones are connected with the inferior ligament, and receive most of the fibres of the lateral ligaments. Joint of thumb.

UNION OF THE PHALANGES.—The ligaments of the first joint are the same as those in the metacarpo-phalangeal articulation, viz. two lateral and an inferior. Joints of the phalanges have

The *lateral ligaments* are triangular in form; and each is connected by its apex to the side of the phalanx near the anterior part, and by its base, to the inferior ligament. The *inferior ligament* has the same mode of attachment between lateral and inferior ligament.

the extremities of the bones as in the metacarpo-phalangeal joint, but it is not so strong in this articulation. There is a simple *synovial membrane* present in the joint.

The articulation of the second with the last phalanx is like the preceding joint, both in the number and disposition of its ligaments, and in the surfaces of the bones; but all the articular parts are much less strongly marked.

Surface of the bones.

Articular surfaces. — The anterior end of each phalanx is marked by a pulley-like surface, and is received into a transversely hollowed fossa on the contiguous one; and the posterior end of the phalanx is provided with a crest to fit into the central depression of the opposite articular surface.

TABLE OF THE CHIEF ARTERIES OF THE UPPER LIMB.

The subclavian is continued in the arm by

- 1. Axillary artery -
  - Superior thoracic
  - acromial thoracic -
    - Muscular
    - inferior acromial
    - humeral thoracic.
  - long thoracic
  - alar thoracic
  - subscapular - - -
    - Dorsal artery - - -
      - Infra-scapular.
    - muscular.
  - anterior circumflex
  - posterior circumflex.
- 2. brachial artery -
  - To coraco-brachialis
  - superior profunda -
    - Muscular to triceps and anconeus
    - anastomotic.
  - nutritious
  - inferior profunda - -
    - Muscular to triceps
    - anastomotic.
  - anastomotic
  - muscular.
- 3. radial artery -
  - Recurrent
  - muscular
  - superficial volar
  - posterior carpal
  - anterior carpal
  - metacarpal
  - dorsal of the thumb
  - of the index finger
  - princeps pollicis
  - radialis indicis
  - deep arch - - -
    - Recurrent
    - perforating
    - interosseous
    - communicating.
- 4. ulnar artery -
  - Anterior recurrent
  - posterior recurrent
  - interosseous - - -
    - Anterior - - -
      - Nutritious
      - muscular.
    - posterior - - -
      - Recurrent
      - muscular.
  - muscular
  - dorsal of the hand, or metacarpal - - -
    - Dorsal carpal
    - metacarpal or interosseous.
  - anterior carpal
  - superficial arch - -
    - Communicating
    - four digital branches
    - cutaneous
    - muscular.

TABLE OF THE VEINS OF THE UPPER LIMB.

Subclavian vein receives the following veins of the arm.

- 1. Axillary vein -
  - Basilic - - - -
    - Salvatella and dorsal arch
    - anterior ulnar cutaneous
    - posterior ulnar cutaneous
    - median basilic.
  - anterior circumflex
  - posterior circumflex
  - subscapular - - -
    - Thoracic branches
    - dorsal branch - - -
      - Infrascapular.
  - brachial veins
  - alar thoracic
  - long thoracic
  - acromial thoracic
  - superior thoracic
  - cephalic - - - -
    - Cephalic of the thumb and the dorsal arch
    - cutaneous radial veins
    - median cephalic
    - cutaneous of the arm.
- 2. brachial vein -
  - Anastomotic
  - muscular
  - inferior profunda
  - nutritious
  - superior profunda.
- 3. radial vein
  - Deep arch - - -
    - Recurrent
    - interosseous
    - perforating.
  - radialis indicis
  - magna pollicis
  - dorsal of index finger
  - dorsal of thumb
  - metacarpal
  - carpal
  - superficial volar
  - communicating to cutaneous radial
  - muscular
  - recurrent.
- 4. ulnar vein
  - Superficial arch - -
    - Communicating to the deep arch
    - digital.
  - metacarpal
  - carpal
  - communicating to ulnar cutaneous
  - muscular
  - interosseous - - -
    - Anterior - - - -
      - Nutritious
      - muscular.
    - posterior - - - -
      - Recurrent
      - muscular
      - carpal.
  - posterior recurrent
  - anterior recurrent.

TABLE OF THE SPINAL NERVES OF THE UPPER LIMB.

- BRACHIAL PLEXUS gives off below the clavicle -
  - Anterior thoracic - -
    - Superficial
    - deep.
  - subscapular - - -
    - Superior
    - inferior
    - long.
  - circumflex - - -
    - Articular
    - cutaneous
    - to teres minor
    - to deltoid.
  - nerve of Wrisberg.
  - internal cutaneous - -
    - Small cutaneous
    - anterior of fore-arm
    - posterior of fore-arm.
  - musculo-cutaneous -
    - To coraco-brachialis
    - biceps and
    - brachialis anticus
    - cutaneous external of fore-arm
    - articular to carpus.
  - median - - - -
    - To pronator teres
    - to muscles of fore-arm, except flexor ulnaris and part of profundus
    - anterior interosseous
    - cutaneous palmar
    - to muscles of thumb in part
    - five digital branches.
  - ulnar - - - -
    - Articular to elbow
    - to flexor carpi ulnaris
    - to flexor profundus in part
    - cutaneous branch of fore-arm and palm
    - dorsal cutaneous of the hand
    - superficial palmar division
      - Communicating
      - two digital branches.
    - deep palmar nerve.
  - musculo-spiral - -
    - Internal cutaneous
    - to triceps
    - and anconeus
    - external cutaneous
    - to supinator and extensor radialis longus
    - posterior interosseous -
      - Muscular
      - articular.
    - radial - - - -
      - Cutaneous of back of thumb, and of first two fingers and half the next.

CHAPTER IV.

DISSECTION OF THE THORAX.

Section I.

CAVITY OF THE THORAX.

Elements of thorax. Situation. Contents.

The thorax is formed by the spinal column, by the ribs and their muscles, and by the sternum. It is situate between the upper limbs and above the abdominal division of the body. In it are contained the lungs, the heart and its great vessels, together with the parts that pass through the cavity to the stomach and the diaphragm, or in the opposite direction to the neck.

Dissection to open thorax.

Dissection. — When the parts that cover the thorax in front have been removed, and the structures in the parietes examined, the cavity is to be opened by the removal of the sternum and the anterior part of the wall. To make a sufficient opening into the thorax, saw through the sternum opposite the interval between the first two ribs, and between the insertion of the cartilages of the fifth and sixth ribs. After detaching the lining membrane (pleura) from the inner surface of the chest, cut through all the true ribs, except the first and last, as far back as the student can conveniently reach. The loose sternum and ribs are to be taken away, by dividing the intercostal muscles in the first and sixth spaces. When the bag of the pleura is opened, and the internal mammary artery cut across, the cavity and the contents of the thorax will be exposed.

Sternum to be kept.

The sternum and the cartilages of the ribs will be hereafter required for the examination of the ligaments.

Form of the thorax.

Form and boundaries of the thorax. — The cavity of the thorax is conical in form, and appears, now the lungs are collapsed, to be only partly filled by the contained viscera; but during life, when the lungs are expanded in respiration, the whole of the space is occupied by those organs.

The apex of the cavity is placed upwards at the root of the neck, and is wider from side to side than from before backwards. It is bounded behind by the first dorsal vertebra, in front by the sternum, and on each side by the first rib. Through the space, thus enclosed, pass the trachea and the œsophagus, with the great vessels of the head, neck, and upper limbs, some nerves of the chest, and the thoracic duct. All these will be afterwards fully seen.

Apex of the cavity is at the neck.

Parts passing through it.

The base of the thorax is also widest transversely, and is sloped very obliquely from before backwards. The hard parts around consist of the end of the sternum in front, the last dorsal vertebra behind, and the ribs below the seventh on each side. Attached along the line of the base just mentioned is the diaphragm, which separates the cavities of the abdomen and thorax.

Base is below, corresponding to diaphragm.

The anterior boundary is about half the extent of the posterior, and is formed by the sternum, the front of the ribs, and the intercostal muscles; whilst the posterior part is constructed by the spinal column, the back of the ribs, and their interposed muscles.

Anterior and posterior wall.

The width of the thorax is increased during inspiration by the elevation and separation of the ribs; but the greatest alteration in the capacity is occasioned by the condition of the diaphragm. During expiration the diaphragm ascends to a level with the fourth intercostal space, and during inspiration it descends so as to become almost flat. Naturally, the height to which the muscle reaches is greater on the right than on the left side. From the yielding nature of this partition between the chest and the abdomen, it is evident that the capacity of the former cavity may be diminished by the presence of fluid in the abdomen, or by the enlargement of the abdominal viscera.

Size of chest influenced by state of ribs and diaphragm, and by state of the abdomen and its viscera.

THE PLEURÆ.

The pleuræ are two serous membranes, one on each side of the spine, which are reflected around the lungs in the cavity of the thorax, and facilitate the movement of those organs in respiration.

Sac of the pleura.

Form.

Each pleura is a sac of a conical form, whose apex projects into the neck above the first rib, and whose base is in contact with the diaphragm. Surrounding the lung, and lining the interior of one half of the chest, the serous membrane consists of a parietal part (pleura costalis), and of a visceral part (pleura pulmonalis). The outer surface is rough, and is connected to the lung and the wall of the chest by cellular membrane, but the inner surface is smooth and secerning. The interior of the sac of one side does not communicate with the cavity of that of the opposite side, though the bags of the pleuræ approach one another in the middle line, forming a partition (mediastinum) between the two sides of the chest.

Disposition in thorax. Outer surface. Inner surface.

Difference in sac of right and left side.

There are some differences in the shape and the extent of the two pleural bags. On the right side the bag is shorter and wider than on the left side, and projects higher into the neck. On the left side the sac is narrowed by the projection of the heart against it.

The sac is continuous over lung.

The continuity of the bag of the pleura over the lung, and along the wall of the chest, may be proved by tracing it circularly from a given point to the same, in the following manner : —

The continuity is here traced.

Supposing the membrane to be followed outwards from the sternum, it may be traced on the walls of the chest as far as the spinal column ; here it is directed forwards to the root of the lung, and is reflected over that organ, covering both aspects, and connecting together its different lobules. From the lung the pleura may be seen to course over the side of the pericardium to the sternum. Above the root of the lung the serous membrane forms a circle without deflection ; and below the root it gives rise to a thin fold (ligamentum latum pulmonis), which intervenes between the lung and the side of the pericardium.

Along middle of chest the sacs form a partition.

The mediastinum. — Where the pleural bags approach one another in the middle line, they form, as before said, a partition, or mediastinum, between the right and left halves of the thoracic cavity. This septum is not straight between the sternum and the vertebral column, but is deflected in the centre by the heart and the great vessels, so as to give

occasion for describing it as consisting of two parts, one in front of, and one behind the heart.

a. The *part in front of the heart* (anterior mediastinum) extends from the back of the sternum to the pericardium, and is formed on each side by the pleural bag. As the pleuræ of opposite sides are not in contact, a space is left between them behind the sternum, which is narrowed about the middle, and is directed to the left side below. In the upper part of the space are the remains of the thymus gland and the origin of the sternal muscles of the neck; and in the lower part is some cellular tissue, together with the triangularis sterni muscle of the left side. Part of septum in front of the heart encloses a space of hour-glass shape.

b. The *part behind the heart* (posterior mediastinum) intervenes between the spinal column and the back of the pericardium and the roots of the lungs. Its lateral boundaries are the pleural bags, which are separated by a larger interpleural space than in the part of the mediastinum in front of the heart. If the pleura is divided behind the lung on the right side, the extent of the space will be seen. In this space are contained the different parts that enter or leave the thoracic cavity, viz. the aorta, the vena azygos, and the thoracic duct, together with the œsophagus and its nerves, the trachea, the splanchnic nerves at the lower part, and some lymphatic glands. Part behind heart encloses a larger space. The contents of the space.

Dissection.—Take away the pleura and the fat from the side of the pericardium, and from the front and back of the root of the lung, without injuring the vessels. In this dissection the phrenic artery and nerve will be exposed in front of the root, together with a small plexus of nerves (anterior pulmonary), which is best seen on the left side. Behind the root of the lung is the large vagus nerve. For the present, the arch of the aorta and the small nerves on it may be left untouched. Clean the root of the lung.

CONNECTIONS OF THE LUNG.

The lungs are two in number, and are contained in the cavity of the thorax, one on each side of the spinal column. In these organs the changes in the air and blood during respiration take place. Number and use.

The lung is of a conical form, and is covered by the bag of the pleura. It presents for examination a base and apex, two borders, two surfaces, lobes, and fissures, together with Form.

a root composed of the vessels and the nerves entering the organ.

Base touches diaphragm. The base of the lung is somewhat hollowed, and is moulded on the convexity of the diaphragm. Following the shape of that muscle, it is sloped obliquely from before backwards, and in consequence reaches much lower at the posterior than at the anterior part. Apex is in the neck. The apex is rounded, and projects above the first rib, where it lies beneath the anterior scalenus muscle and the subclavian artery.

Anterior edge is thin and notched. The anterior edge or border is thin and oblique, is often notched, and overlays the pericardium. On the left side this edge is excavated opposite the apex of the heart. In the right lung two fissures are seen in this border, but in the left lung there is only one. Posterior edge is thick. The posterior border is longer than the anterior, and projects inferiorly between the ribs and the diaphragm; it is thick and vertical, and is received into the hollow by the side of the spinal column.

External surface. On the outer aspect the lung is convex, and is in contact with the wall of the thorax. A large cleft divides this surface into two parts, lobes of the lung, and on the right side there is a second smaller fissure. Internal surface The inner surface is flat when compared with the outer, and is marked by the following inequalities: — Altogether in front, is the hollow corresponding to the heart, which is greatest on the left lung; gives attachment to the root. behind this, but nearer the posterior than the anterior border, is a fissure about three inches long (hilum pulmonis), which receives the vessels forming the root of the lung.

Division into lobes. Each lung is divided into two parts or lobes by an oblique fissure, that begins near the apex and ends in the anterior border near the base. Left has two, From the form of the lung and the direction of the fissure, the lower lobe is necessarily the largest. and the right three lobes. In the right lung a second horizontal fissure is directed forwards from the middle of the oblique one to the anterior border, and cuts off a small triangular part, or a third lobe, from the upper lobe. Occasionally there may be found a trace of the third lobe in the left lung.

Difference in form and size of the lungs. Besides the difference in the number of lobes, the right lung is larger and heavier, and is wider and more hollowed out at the base than the left, but it is shorter by an inch.

The increased length and the narrowness of the left lung are due to the absence below of any large projecting body like the liver, and to the direction of the heart to the left more than to the right side.

Root of the lung.—The vessels of the lung entering the fissure on the inner surface are bound together by the pleura and cellular membrane, giving rise to a foot-stalk or root, which fixes the lung to the heart and the trachea. The root is situate about midway between the base and apex, and about a third of the breadth of the inner surface from the posterior border of the lung. In front of the root, on both sides, are the phrenic nerve and the anterior pulmonic plexus, but anterior to the right root is the descending cava. Behind, on both sides, is the posterior pulmonic plexus; and on the left side there is, in addition, the descending aorta. Above, on the right side, is the vena azygos, and on the left side the arch of the aorta. Below each root is the fold of pleura called ligamentum latum pulmonis.

Root of lung. Situation. Connections.

In the root of the lung are found the vessels connected with the function of respiration, viz. a division of the air tube (bronchus), a branch of the pulmonary artery, and two pulmonary veins; together with small nutritive bronchial arteries and veins, and some nerves and lymphatics. These different parts have a special position to one another, thus:—

Constituents of the root;

On both sides, the bronchus is most posterior, the pulmonary veins most anterior, and the pulmonary artery between the other two. In the direction from above downwards, the position on the right side is, bronchus, pulmonary artery, and pulmonary veins; but on the left side there is a slight difference, owing to the bronchus and artery having changed places; consequently the relative position will there be, artery, bronchus, and veins. This difference in the two sides may be accounted for by the fact of the left division of the air tube being lower than the right one.

their relative position.

THE PERICARDIUM.

The bag that contains the heart is named the pericardium. It is situate in the middle of the thorax, in the

Situation.

interval between the pleuræ of opposite sides, where they approach to form the mediastinum. Before proceeding with the anatomy of this sac, the following dissection should be undertaken :—

Clean vessels of heart and seek small nerves crossing arch of aorta.

Dissection.—Supposing the surface of the pericardium to be already cleaned, the student should next expose the large arteries and veins connected with the heart. He should afterwards seek carefully the following nerves, crossing the arch of the aorta :— the nerve most to the left, and the largest, is the vagus; to the right of the vagus, and next largest in size, is the phrenic nerve. Between the two preceding, and close to the coats of the artery, are the two following small nerves: the left superficial cardiac nerve of the sympathetic, and the cardiac branch of the left vagus; of the two, the last is smallest, and to the right.

Dissect superficial plexus in arch of aorta.

The two cardiac nerves of the vagus and sympathetic are to be followed onwards to a small plexus (superficial cardiac) in the concavity of the aorta. An offset of the plexus is to be traced downwards between the pulmonary artery and the aorta, towards the anterior coronary artery of the heart; and another prolongation will be found coming forwards by the side of the arterial duct, from the deep cardiac plexus, to join the superficial plexus. When the pericardium is opened, the nerves will be followed on the heart, but their dissection is difficult, and will require some care. Oftentimes these small nerves are destroyed in injecting the body.

Connections of the pericardium.

The pericardium is larger than the viscus it contains, and projects more towards the left than the right side of the chest. Somewhat conical in form, the wider part of the bag is turned towards the diaphragm, and the narrower part upwards towards the large vessels of the heart. Laterally, the pericardium is covered by the pleura, and the phrenic nerve and vessels lie in contact with it. Its anterior and posterior surfaces correspond to the spaces contained in the mediastinum. This envelope of the heart consists of a fibrous structure, which is lined internally by a serous membrane.

Fibro-serous case.

Fibrous part gives sheaths to vessels.

a. The *fibrous* part surrounds the heart entirely, and gives prolongations to the vessels that pierce it. Of these different sheaths that on the aorta is the strongest. Inferiorly, it is united by fibres to the central tendon of the diaphragm, to the left of the middle line, only about an inch

Joins diaphragm.

extending to the right of that line. This membrane is thickest at the upper part, and is formed of fibres that cross in different directions, many being longitudinal. When the pericardium is cut open, the serous lining will be visible. Its structure.

b. The *serous* layer lines the interior of the fibrous pericardium, and is reflected over the surface of the heart. Like other serous membranes, the arachnoid for example, it has a parietal and a visceral part. Lining the interior of the fibrous layer, to which it gives the shining appearance, the membrane is then conducted to the surface of the heart by the different vessels. As it is reflected on the aorta and the pulmonary artery, it contains those vessels in one tube, not passing between their contiguous surfaces; and at the posterior part of the pericardium it forms a pouch between the pulmonary veins of opposite sides. The cavity of the serous sac is lubricated by a thin fluid. Serous layer lines fibrous, and covers surface of heart. Peculiarities in its reflections.

The *vessels* of the pericardium are derived from the internal mammary, the bronchial, the œsophageal, and the phrenic arteries. Vessels.

THE HEART AND LARGE VESSELS.

The heart is a hollow muscular body, which is divided into compartments by septa. It is the chief agent in the propulsion of the blood through the body, and is also the centre of the vascular system, for into it all the veins enter, and from it the arteries issue. This hollow body is centre of circulation.

When the heart is distended, its form is somewhat conical, with the oval wider part directed upwards and to the right, and the rounded apex turned downwards and to the left side of the chest. Rather flattened from before backwards, the heart presents two surfaces and borders. The anterior surface is slightly convex, whilst the posterior is nearly flat. The left border is thick and round, but the right is thin and less firm. Form. Surfaces and borders.

In size it varies greatly, and in general the heart of the woman is smaller than that of the man. The measurements may be said to be commonly four inches and three quarters in length, three inches and a-half in width, and two inches and a-half in thickness. Size.

The heart is divided into four cavities,

On the surface of the heart are certain grooves, indicatory of its divisions into different compartments. Thus passing circularly round the heart, nearer the base than the apex, is a groove which marks the division into two parts, auricular and ventricular. The auricular part is placed at the base of the heart, and is subdivided into two cavities (right and left) by a median partition. In like manner the ventricular portion is parted into right and left ventricles by a septum. The situation of the median partition between the auricles and ventricles is recognised by a longitudinal sulcus on the surface. But it will be seen that this sulcus does not occupy the mid space either on the anterior or the posterior aspect of the heart, but is nearer the left border in front, and the right border behind, so that most of the anterior surface of the heart is formed by the right cavities (auricle and ventricle), and the greater part of the posterior surface by the corresponding left cavities.

two auricles,

and two ventricles,

by partitions corresponding to the grooves on surface.

Situation of heart to wall of chest.

Occupying the middle line of the chest, the heart projects also to the left side; and it may be said to reach one inch or one inch and a-half to the right of the centre of the sternum, and three inches to three inches and a-half to the left of that line. Its position to the axis of the body is oblique from right to left, with the left border upwards, and the right border downwards. The apex is opposite the space between the cartilages of the fifth and sixth ribs of the left side, "two inches below the nipple, and one on its sternal side." The aperture of one of the large arteries of its base (pulmonary) is beneath the cartilage of the third rib of the left side, close to the sternum; and the opening of the other artery (aorta) is between the cartilages of the third and fourth ribs of the same side, also close to the sternum.*

Situation of apex

and arterial openings.

The heart is double

The heart is a double organ, and consists of two similar halves, right and left. In each half are two cavities, an auricle and a ventricle, which communicate, and are provided

* The position of the several parts of the heart with respect to the wall of the chest is given more fully and somewhat differently by Mr. Sibson in his Papers in the twelfth volume of the Transactions of the Provincial Med. and Surg. Association.

with special vessels for the entrance and exit of the blood. The right half receives black blood by the systemic veins, and sends the same through the lungs by means of the pulmonary artery; but the left half is supplied with red blood from the lungs through the pulmonary veins, and distributes its contents over the body through the canal of the aorta. each half having an auricle and ventricle.

The *auricles* are two, as before said (right and left), and are placed at the base of the heart behind the aorta and the pulmonary artery. They receive their appellation from the resemblance that the tips or appendices projecting forwards on the sides of the arteries bear to a dog's ears. The auricles are much thinner than the ventricles, and are recipients of blood from large veins. Of the two, the right is rather the larger and more anterior; it is joined by the upper and the lower cava, and by the veins of the substance of the heart. The left cavity receives the two pulmonary veins on each side. Situation o the auricles. Veins join these cavities. Right. Left.

The *ventricles* constitute the fleshy part of the heart, and are thicker than the auricles, below which they lie. Two in number, like the auricles, each has an opening into the auricle of its own side, by which it receives blood, and another opening into an artery, by which the blood is transmitted from the cavity. Their unequal extent on the aspects of the heart has been before alluded to: thus the right ventricle forms the right thin border, and the greater part of the anterior surface, and is prolonged upwards on the left side into the pulmonary artery. The left ventricle enters alone into the apex, the left border, and most of the posterior aspect of the heart: with this cavity the aorta is connected. The ventricles communicate with arteries. The right The

Dissection.— Before opening the heart, the vessels for the nutrition of its substance (coronary arteries) should be dissected on the surface, together with the small nerves that accompany them. The small vessels appear on the sides of the pulmonary artery, and occupy the grooves on the surface of the heart, where they are surrounded by fat; one branches over the right, and the other over the left side. With the anterior artery is a plexus of nerves, which is to be followed upwards to the superficial cardiac plexus; with the remaining artery is another plexus. Dissect coronary vessels and nerves.

The *coronary arteries* are two small vessels that are so Two

arteries of the heart, viz. named from their course around the heart. They are the first branches of the aorta, and arise close above the semi-lunar valves. One is distributed on the right and the other on the left side of the heart.

right coronary, *a.* The *right coronary* branch appears on the right side of the pulmonary artery, and is directed onwards in the depression between the right auricle and ventricle, to the posterior aspect of the heart, where it anastomoses with a similar circular offset from the left coronary artery. In this course branches are distributed upwards and downwards to the right half of the heart. Two of these are of larger size than the rest: one runs on the anterior aspect of the right ventricle towards its free margin; the other descends on the back of the heart, along the septum between the ventricles, and anastomoses towards the apex with the left coronary artery.

left coronary artery. *b.* The *left coronary* branch is inclined behind the pulmonary artery to the left side of that vessel, then in the groove between the left auricle and ventricle to the back of the heart, on which part it anastomoses with the right coronary branch. Like the preceding artery, it furnishes offsets to the substance of the auricle and ventricle. The largest of these descends in the anterior sulcus, over the partition of the ventricles, towards the apex of the heart, and communicates with the descending branch of the right coronary artery at the back of the heart.

Veins of the heart. The *veins* of the substance of the heart (cardiac) are not the same in number, nor have they the same distribution as the arteries. For the most part they are united into one large trunk (great cardiac), which opens into the right auricle.

Large cardiac vein is single *a.* The *great cardiac* or *coronary* vein begins near the apex of the heart in the substance of the ventricles, both before and behind, but its principal root lies on the left part of the anterior aspect of the heart, over the septum between the ventricles. From this origin, in front, the vessel turns to the back of the heart in the sulcus between the left auricle and ventricle, and opens into the under part of the right auricle. It receives collateral branches in its course, and one of these, which is larger than the rest (middle cardiac vein), is placed over the septum of the ventricles at the back of the heart.

and opens into back of right auricle.

b. Some small *anterior cardiac* veins on the anterior part of the right ventricle open separately, by one or more trunks, into the lower part of the right auricle. Similar small veins exist over the right auricle and the back of the right ventricle. Small anterior cardiac veins.

c. A third set of veins (veins of Thebesius, venæ minimæ) lie in the substance of the heart: these are noticed in the description of the right auricle. Smallest cardiac.

Cardiac nerves. — The nerves for the supply of the heart are derived from a large plexus (cardiac) around the roots of the aorta and pulmonary arteries. Part of this plexus is superficial to the pulmonary artery, and part beneath; and from each an offset is sent with a coronary artery. Only the superficial part is now exposed. Cardiac nerves.

The small *superficial cardiac plexus* is placed by the side of the ductus arteriosus, and below the arch of the aorta. The nerves that join it are the left superficial cardiac nerve of the sympathetic, and the small cardiac branch of the left vagus (p. 106.), and a considerable bundle of nerves comes forward to it from the deep cardiac plexus. A small ganglionic mass is sometimes seen in the plexus. Inferiorly, the plexus ends in nerves to the heart that accompany the right coronary artery. A few filaments pass on the left division of the pulmonary artery to the front of the root of the lung of the same side. Superficial plexus ends in anterior coronary.

a. The *anterior* or *right coronary plexus* passes downwards from the plexus above described, to reach the right coronary artery, and receives near the heart a communication from the deep cardiac plexus. Anterior plexus of heart.

b. The *posterior* or *left plexus* is derived from the deep cardiac plexus, as will be subsequently seen, and accompanies the left coronary artery to the heart. Posterior plexus.

On the heart the nerves at first surround the arteries, but they soon leave the vessels, and becoming smaller by subdivision, are lost in the muscular substance of the ventricles. Accompany the arteries.

The CAVITIES OF THE HEART should be examined in the order in which the current of the blood passes through them, viz. right auricle and ventricle, and left auricle and ventricle. Four cavities of the heart.

Dissection. — To open the right auricle, make an incision in it near the free border, and from the superior cava nearly to the inferior cava; from the centre of that incision carry the knife across Dissection to open right auricle.

the anterior part to the auricula. By means of these cuts an opening will be made of sufficient size; and on raising the flaps with hooks, the shape of the cavity will be seen after the removal of the coagulated blood it contains. The heart should not be removed from the body to examine its interior.

Form of right auricle. The *cavity of the right auricle* is of an irregular form, though when seen from the right side, with the flaps held up as above directed, it has somewhat the appearance of a cone, with the base to the right and the apex to the left. In its description it will be necessary to speak also of an anterior and a posterior wall or part.

Its base; The base or wider part of the cavity projects on the right side, and at its extremities are the openings of the superior and the inferior cava. Between these vessels the cavity projects somewhat, and presents a slight elevation in some bodies (tubercle of Lower). The apex is prolonged downwards towards the junction of the auricle with the ventricle, and in it is the large opening into the right ventricular cavity.

apex.

Anterior wall presents auricula. The anterior wall is thin and loose, and near its upper part is an opening leading into the pouch of the appendix or auricula, which will admit the tip of the little finger. Around, and in the interior of the appendix, are fleshy bands (musculi pectinati), which cross in different directions, forming a network that contrasts with the general smoothness of the auricle.

Posterior wall is marked by fossa ovalis. The posterior wall corresponds for the most part to the septum between the auricles. On it, nearer the inferior than the superior cava, is a large oval depression, fossa ovalis, which is the remains of an opening in the fetus between the auricles. Inferiorly the fossa merges into the opening of the inferior cava. In the adult, a thin semitransparent partition closes the opening, but there is oftentimes a small oblique aperture at the upper part. Around the upper three fourths of the fossa is an elevated band of muscular fibre (annulus seu isthmus Vieussenii), which is most prominent above and on the inner side, and gradually subsides inferiorly. Altogether at the lower part of the posterior wall, between the opening into the ventricle and that of the inferior cava, is the small aperture of the large coronary vein. Other

Annulus of Vieussens.

small apertures are seen scattered over the surface: some lead only into depressions, but others are the mouths of the veins of the substance of the heart (venæ cordis minimæ), and are named foramina Thebesii.

Apertures of cardiac veins

The chief apertures in the auricle have been said to be those of the two cavæ, of the coronary vein, and of the ventricle. All these, except that of the superior cava, have some kind of valve. The opening of the superior cava is in the front of the auricle, and its direction is downwards and somewhat forwards. The inferior cava opens into the lowest part of the auricle near the septum, and is directed inwards and backwards to the fossa ovalis. In front of the last opening is a thin fold of the lining membrane of the cavity, the Eustachian valve, which is a remnant of a structure that is much larger in the fetus. This valve, in its perfect state, is semilunar in form, the convex margin being attached to the wall of the vein, and the other being free in the cavity of the auricle. Its surfaces are directed forwards and backwards. In size, the valve surpasses the width of the vein, its extremities reaching, therefore, the surface of the auricle, and the left end is connected with the annulus or rim of the fossa ovalis. The free margin of the valve is often reticular. The aperture of the coronary vein in the lower part of the auricle is closed by a thin fold of the lining membrane — valve of Thebesius. The auriculo-ventricular opening will be seen, in examining the right ventricle, to be provided with valves, which prevent regurgitation into the auricular cavity.

Valves of chief apertures. Superior cava. Inferior cava is provided with Eustachian valve. Coronary vein. Auriculo-ventricular opening.

In the adult there is but one current of blood in the right auricle towards the ventricle; but in the fetus there are two; one of pure, and the other of impure blood, which cross one another. The placental or pure blood entering by the inferior cava, is directed by the Eustachian valve chiefly into the left auricle, through the opening in the septum (foramen ovale); whilst the current of systemic blood, of the superior cava, flows downwards in front of the other to the right ventricle.

Course of blood in auricle in adult, and in the fetus.

Dissection. — Seizing the right ventricle, pass the scalpel through it below the opening from the auricle, and bring out the knife near the apex of the heart, without injuring the septum ventriculorum.

To open right ventricle.

A flap is thus formed, like the letter V, of the anterior part of the ventricle. In the examination of the cavity of the right ventricle, the flap and the apex of the heart should be raised separately with hooks, so that the space may be looked into from below.

Cavity of right ventricle. The *cavity of the right ventricle* is triangular in form, and has the base turned upwards to the auricle of the same side. Apex. The point of the cavity reaches the right border of the heart, at a little distance from the apex. Base and its openings. At its base the ventricle is sloped to the right, and is perforated by two apertures; one of these, on the right, leading into the auricle, is the right auriculo-ventricular opening; the other on the left, and much higher, is the mouth of the pulmonary artery. The part of the cavity which communicates with the pulmonary artery is funnel-shaped (infundibulum, conus arteriosus).

Anterior and posterior wall. The anterior wall, or the loose part of the ventricle, is comparatively thin, and forms most of the anterior aspect of the ventricular part of the heart. The posterior boundary corresponds in greatest part to the septum between the ventricles, and is of considerable thickness.

Interior of the cavity is uneven. Over the greater part of the cavity the surface is irregular, and is marked by projecting fleshy bands of muscular fibres (columnæ carneæ), but near the aperture of the pulmonary artery the wall becomes smooth. On it there are three sets of fleshy columns. The fleshy columns are of various sizes, and have three different dispositions in the cavity. Some merely form a prominence in the ventricle, as on the septum. Others are attached at each end, but free in the middle (trabeculæ carneæ). And a third set, which are fewer in number, and much the largest, project into the cavity, and form rounded bundles (musculi papillares), which give attachment by their free ends to the little cords of the valve of the auriculo-ventricular opening.

Opening from the auricle to the ventricle. The auriculo-ventricular orifice is situate in the base of the ventricle near the right, or the free border of the heart, and is larger than the corresponding aperture of the left side of the heart. It is oval from side to side, and its shape is maintained by a strong fibrous band that surrounds it. Prolonged from the circumference of the opening is a thin membranous valve, which projects into the cavity of the ventricle, and is serrated or divided into points at its free

margin; and to its lower or free margin are attached small tendinous cords (chordæ tendineæ) that unite it to the muscular bundles of the ventricle. From a difference in the moveableness of parts of the valve, and from the mode of attachment of the tendinous cords, the valve has been divided into three parts, and named tricuspid. One slip or tongue (anterior) is next the front of the ventricle, and is fixed to the fleshy columns of that part. Another (posterior) is contiguous to the septum ventriculorum, and is very short. Whilst the remaining tongue (left) is the largest and most moveable, and lies between the apertures into the auricle and pulmonary artery; the borders of this piece are turned forwards and backwards, and receive the tendinous cords by which it is fixed on the one side to the upper part of the septum, and on the other to the front of the ventricle. The tricuspid valve is constructed of the lining membrane of the heart, which encloses bands of fibrous tissue derived from the circumference of the auriculo-ventricular opening. During the contraction of the ventricle the valve is raised by the blood, so as to close the opening into the auricle, but the farther protrusion of it into the latter cavity is arrested by the small tendinous cords.

is guarded by the tricuspid valve.

Attachment of the three parts by tendinous cords.

Its structure

and use.

The mouth of the pulmonary artery will be seen when the incision in the anterior wall of the ventricle is prolonged upwards into it. It is situate on the left of the opening into the auricle, and into it the left or funnel-shaped part of the right ventricle (infundibulum) is prolonged. In its interior are three semilunar or sigmoid valves. Each valve is attached to the side of the vessel by its convex border, and is free in the cavity by the opposite border, in which there is a slight, thickened, and projecting part (corpus Arantii). The valves are formed by fibrous tissue, covered by the lining membrane of the vessel. The use of these little valves is obvious, viz. to give free passage to fluid in one direction, or to close the area of the vessel. Whilst the blood is entering the artery, the valves are placed against the wall; but when the vessel acts on the contained blood, the valves are thrown towards the centre of the cavity, and prevent the return of the circulating fluid into the ventricle.

Mouth of pulmonary artery

has three semilunar valves;

their attachment,

structure,

and use.

To open left auricle.

Dissection. — To open the cavity of the left auricle, raise the apex of the heart, and make a cut across the posterior surface from the right to the left pulmonary veins. Another incision should be made into the auricula. The apex of the heart must necessarily be kept raised during the examination of this auricle.

Shape of cavity of left auricle.

The *cavity of the left auricle* is smaller than that of the right side, which it nearly resembles. Irregularly conical in shape, the wider part is turned to the spinal column, where it receives the pulmonary veins, and the narrower part opens inferiorly into the left ventricle.

On anterior wall is auricula.

On the anterior wall is the aperture of the pouch of the auricula, which is narrower than on the right side. In the interior of the pouch, as well as around the entrance, are the fleshy fibres (musculi pectinati), which resemble those before seen in the other auricle.

On posterior, remnant of foramen ovale.

On the right side, or on the part of the wall corresponding to the septum auricularum, is a superficial fossa, or the remains of the oval aperture through that partition. This impression in the left auricle is above the fossa ovalis in the right cavity, because in the fetus the aperture of communication between the two was an oblique canal through the septum.

Openings of the auricle are, one into ventricle and four pulmonary veins.

The apertures of the auricle are the four pulmonary veins, two on each side, together with the opening of communication with the left ventricle. The mouths of the two pulmonary veins on each side are close to one another; those of the right lung open into the extreme right of the auricle near the septum, and those of the left lung enter the opposite part of the cavity, near the auricula. These veins are not provided with valves. The aperture into the ventricle will be afterwards seen to have a large and complicated valve, as on the right side, to guard it.

Current of blood in adult; in fetus.

In the adult, the blood enters this cavity by the pulmonary veins, and passes to the left ventricle by the large inferior opening between the two. In the fetus, however, the lungs are impervious to the air and the circulating fluid; and the left side of the heart receives its pure blood from the right auricle through the aperture in the septum (foramen ovale).

How to

Dissection.—Open the left ventricle by an incision along the an-

terior and posterior surfaces near the septum, but without cutting so far upwards as to reach the auricle. On raising the triangular flap, the interior of the cavity will be seen.

open left ventricle.

The *cavity of the left ventricle* is more conical in shape than that of the opposite ventricle, and on a transverse section of the heart it appears almost circular.

Form of left ventricle.

The apex of the cavity reaches into the apex of the heart, for the fibres of the left ventricle alone form this part. The base is turned towards the auricle, and is sloped slightly from right to left, or in a direction opposite to that of the right ventricle. In this part are the openings into the aorta and the left auricle.

Apex. Base with its openings.

The walls of this ventricle are thickest, and the anterior boundary is formed by the septum ventriculorum.

Walls.

Like the right ventricle, its surface is irregular, in consequence of the projections of the fleshy columns (carneæ columnæ), but near the great artery (aorta) that leads from the cavity the surface is smooth. Here are seen the same three sets of fleshy columns as in the right ventricle, but the set that project into the cavity and receive the small tendinous bands of the valve are the most marked: of these muscular projections (musculi papillares) two are generally larger than the rest, and are attached to the wall of the ventricle near the septum.

Inner surface has fleshy columns, but some very large.

The aperture of the left auricle is placed on the left of the orifice of the aorta, and close to it, only a thin fibrous band intervening between the two. This opening is smaller than the corresponding aperture of the right side, and like it is longest in the transverse direction. It is furnished with a membranous valve that projects into the ventricle, but is stronger and of greater length than the tricuspid, and has also firmer and more tendinous cords. Attached to a fibrous ring around the aperture, the valve is divided below into two instead of three pieces, and from its fancied resemblance to a mitre it has been called mitral valve. One tongue of the valve intervenes between the auricular and aortic openings, being attached above to the band in that position, and is larger and looser than the other or posterior division. The margins of the pieces of the valve are turned forwards

Left auriculo-ventricular aperture. Form and size. It has a large valve named mitral.

Pieces of

the valve. and backwards, and into their edges are inserted the tendinous cords that attach the valve to the muscular bundles (musc. papillares). Use. The use and action of the mitral valve during the contraction of the ventricle are altogether similar to the action and use of the tricuspid valve.

Aortic opening; The opening of the aorta is somewhat on a higher level than that of the auricle, and is next the septum of the ventricles. position and form. By slitting the side of the vessel without cutting the pulmonary artery, its aperture will be found to be round, and rather smaller than that of the pulmonary artery, beneath which it lies. Is guarded by three sigmoid valves. In its interior are three semilunar or sigmoid valves, which are larger and stronger than the analogous parts in the pulmonary artery, but have the same structure, attachment, and function. The projection in the centre of each valve (corpus s. nodulus Arantii) is also better marked. Opposite each valve the coat of the aorta is swollen out, and presents a little hollow on the inner side (sinus of Valsalva). Above the free margin of two of the small valves are the apertures of the coronary arteries.

Relative position of the apertures of the heart. Two openings have been seen in each ventricle, one of the auricle of its own side of the heart, and one of an artery. The apertures of the arteries (aorta and pulmonary) are nearest the septum; and as the two vessels were originally formed from one tube, they are close together, the pulmonary artery being the more anterior of the two. The aperture of communication with the auricle is next the side of the heart (the right in the one case, and the left in the other), and is posterior to the position of the arteries that issue from the fore part of the ventricles. From right to left. The relative position of the openings from right to left will therefore be, first, right auriculo-ventricular opening; then that of the pulmonary artery; next the mouth of the aorta; and, lastly, the left auriculo-ventricular aperture.

Structure of the heart is fibrous and muscular. STRUCTURE. — The heart is composed of a mass of muscular fibres, and of certain fibrous rings which serve as fixed points for their attachment. These structures must be studied on the heart of the ox or sheep, in which the fibres have been hardened and separated by boiling.

Fibrous bands The *fibrous structure* forms rings around the auriculo-

ventricular and arterial orifices, and sends prolongations into the valves connected with those openings.

a. The *auriculo-ventricular rings* give attachment to the muscular fibres both of the auricles and ventricles, as well as to the framework of fibrous tissue in the tricuspid and mitral valves. These rings are distinct from the circles around the arterial openings, except at the right part of the left auriculo-ventricular opening, where the auricular and the arterial rings are blended. forms rings around auriculo-ventricular openings,

b. An *arterial ring* surrounds each large artery (aorta and pulmonary), fixing those vessels, and giving attachment to the muscular fibres and the semilunar valves. Each is a circular band, with an uninterrupted margin towards the ventricle, and a toothed or wavy margin towards the artery. This last margin has three notches, which are filled by corresponding projections of the artery, and give attachment to the sigmoid valves along their semilunar edges. and around arterial openings. To these last the sigmoid valves

The artery is connected with the ring of fibrous tissue in the following manner:—The middle coat presents three projecting convex pieces that are received into and connected with the notches of the fibrous ring; and the union between the two is further strengthened externally by the pericardium, and internally by the endocardium. and middle coat of the artery are fixed.

The *muscular substance* forms concentric bands of fibres, which are arranged mostly in a circular or spiral direction, and enclose the different cardiac cavities. In the wall of the auricles the fibres are quite distinct from those in the ventricles, though both sets are attached to the fibrous rings of the cardiac orifices, as to a common point of origin or insertion. The fibres belong to the involuntary class of muscles, and yet they are marked with transverse striæ. Muscular substance of heart is distinct in auricles and ventricles.

a. In the *wall of the auricles* the fibres are mostly transverse, and are best marked at the lower part, though they form here but a thin layer; some of these fibres dip into the septum between the auricular cavities. Besides this set, there are annular fibres around the appendages of the auricles and the openings of the different veins. Lastly, a few oblique fibres pass upwards over the auricles, but are attached below, both in front and behind, to the fibrous rings surrounding the auriculo-ventricular orifices. Disposition in the auricles, where they are transverse, annular, and oblique.

b. In the *wall of the ventricles* the fibres are disposed in layers, which pass spirally downwards from the base towards the smaller In the ventricles they

pass from base to apex. part of the heart, where they make a sudden bend, and are reflected upwards with a straighter direction and a deeper position, to form the inner surface of the ventricular cavity. To allow of this turning inwards of the fibres, the deepest layers extend the shortest distance from the base of the ventricle. Each ventricle has, for the most part, its own formative fibres, which assist in constructing the septum between the cavities; but some bands are concerned in the production of the wall of both ventricles on the anterior aspect of the heart, and especially near the base of the ventricles, where the fibres are nearly circular in direction, and cross the posterior interventricular groove. When these intercommunicating fibres are divided, the ventricles may be detached from one another.*

The fibres of the ventricles are mostly separate, but some common to both.

Lining membrane of the heart

Endocardium. — Lining the interior of the cavities of the heart is a thin membrane, which is continuous on the one hand with the lining of the veins, and on the other with that of the arteries. This membrane is so named in opposition to the external investment or pericardium. Where the membrane passes from the auricle to the ventricle, or from the ventricle to the artery, it forms duplicatures or valves, in which fibrous tissue is enclosed. In the ventricle it also covers the tendinous cords of the valves and the projecting muscular bundles. The thickness of the membrane is less in the auricles than in the ventricles.

forms folds in the interior by covering fibrous tissue.

Vessels of base of the heart

GREAT VESSELS OF THE HEART. — The arteries that take origin from the heart are the pulmonary artery and the aorta. The large veins entering the heart besides the coronary, which have been examined, are the superior and inferior cava, and the pulmonary veins.

The pulmonary artery

The PULMONARY ARTERY is a short thick trunk that conveys the dark or impure blood from the right side of the heart to the lungs. From its origin in the right ventricle, the vessel is directed upwards on the left of the aorta, and at a distance of an inch and a-half or two inches from its origin, divides into two branches, of nearly equal size,

is a short trunk,

* For fuller detail concerning the structure of the heart, the student may refer to the articles "Heart" and "Fibres of the Heart," in the Cyclopædia of Anatomy and Physiology.

for the lungs. Near the bifurcation of the artery is a small ligamentous cord (ligamentum ductûs arteriosi), which is the remnant of the arterial duct, and passes from the left branch to the arch of the aorta. The trunk of the pulmonary artery is contained in the pericardium, and beneath it is the beginning of the aorta, together with the left auricle. On each side are the coronary artery and the auricula.

and divides into two for the lungs.

Connections.

The *right branch* is longer than the left, and in its course to the lung it lies beneath the aorta and the vena cava superior, and rests on the bronchus, or division of the air tube. As it passes outwards, the vessel is above the level of the right auricle of the heart. At the lung the artery divides into three primary branches, one for each lobe, which enter the pulmonic substance.

Right branch is longest.

The *left branch* is rather smaller than the right, and is directed in front of the descending aorta and the left bronchus to the fissure of the root of the lung, where it divides into two branches that are distributed to the lobes.

Left branch.

As the right and left branches of the pulmonary artery pass outwards they cross the divisions of the air tube, and enclose therewith a lozenge-shaped space, which contains some bronchial glands.

Space at the bifurcation.

In the fetus the part of the pulmonary artery which is now ligamentous is the continuation of the trunk of the vessel, and is larger than either branch to the lung. At that period the part above referred to receives the name arterial canal or duct (ductus arteriosus, Botalli), and opens into the aorta rather beyond the origin from the arch of the last great vessel of the head and neck. As the lungs do not purify the circulating fluid before birth, the blood of the pulmonary artery is passed into the aorta below the attachment of the vessels of the head and neck, in order that it may be transmitted to the placenta; but after birth the function of the lungs is established, and the current of blood is directed into the pulmonary arteries instead of the arterial duct; and this last channel becomes gradually smaller until it is quite obliterated.

Condition of the artery in the fetus.

The AORTA is the great systemic vessel that conveys the blood from the heart to the different parts of the body. Commencing near the front of the chest, the vessel first arches

This great vessel extends

through chest and abdomen. backwards to reach the spinal column, on which it afterwards takes its position in its extent through the chest and abdomen. In the thorax, the vessel is divided into two parts—arch of the aorta, and the descending or thoracic aorta.

Its first part is arched. *Arch of the aorta.* — From its origin in the left ventricle, opposite the junction of the cartilage of the fourth rib of the left side with the sternum, the aorta is directed to the right, as high as the upper edge of the cartilage of the second rib on the opposite margin of the sternum. Here the arterial trunk turns backwards to reach the left side of the body of the second dorsal vertebra. And lastly, after the length of one vertebra, it becomes descending aorta, viz. at the lower border of the body of the third dorsal vertebra. The arch thus formed has its convexity upwards and to the right, and from it the large vessels for the supply of the upper part of the body take their origin. For the purpose of reducing to order the numerous connections of this portion of the aorta, the arch is divided into three parts — ascending, transverse, and descending.

The extent

and divisions of the arch.

First part: *a.* The first or ascending part is about two inches in length, or slightly more, and crosses behind the sternum, and very near that bone. It reaches as high as the cartilage of the second rib, and is contained nearly altogether in the pericardium. At first the pulmonary artery is superficial to the origin of the aorta; but as these vessels take different directions, the aorta is soon uncovered, and remains so to its termination. On the right side is the descending cava, and on the left, the pulmonary artery. Behind it is the right division of the pulmonary artery. Near the heart the vessel bulges opposite each semilunar valve (sinuses of the aorta), and it is sometimes dilated along the right side (great sinus of the aorta). The two coronary arteries arise close to the swellings above alluded to.

length and connections.

Gives origin to coronary arteries.

Second part is transverse. *b.* The second or transverse part also crosses behind the sternum, and rests upon the trachea above its bifurcation, as well as over the œsophagus. Lying in front of the artery are the pneumogastric, phrenic, and superficial cardiac nerves; and the first nerve sends backwards its recurrent branch beneath the aorta. Along the upper border is the left innomi-

Connections.

Gives

nate vein, and from this border arise the threegreat vessels of the head and the upper limbs. To the lower border, near the termination of the transverse part, the remains of the arterial duct is attached. Origin to large vessels.

c. The third or descending part of the arch is very short, and lies against the third dorsal vertebra and the fibro-cartilage between it and the second vertebra; it is covered by the left pleura. Third part is without vessels.

In the concavity of the arch of the aorta are contained the left auricle of the heart, the root of the left lung, the branching of the pulmonary artery with its arterial duct, and the left recurrent nerve. Deeper than these parts, will be found the œsophagus and the thoracic duct, with some lymphatic glands. Parts contained in the arch.

The *branches* of the arch of the aorta are five in number, two from the ascending, and three from the transverse part. The two first are the coronary arteries of the heart, which have been already noticed (p. 312.). The other three are much larger in size, and supply the head, the neck, and the upper limbs. First on the right is the large trunk of the innominate artery, close to it is the left carotid, and last is the left subclavian, which is distant a small space from the preceding vessel. Five branches of the arch: two coronary, innominate, carotid, subclavian.

Peculiarities.—The exceptions to the usual condition of the arch of the aorta, that the student may expect to find, concern the height or direction of the arch, and the position and number of its branches. Peculiarities.

The arch reaches commonly to about an inch from the upper part of the sternum, but it may ascend nearly to the top of that bone, or stop an inch and a half or more from it. Height and

Sometimes the aorta is arched over the root of the right instead of the left lung, as in birds, and is directed afterwards to its usual place on the spinal column, without any other change in the body. Or, all the viscera of the cavities of the thorax and abdomen may be transposed, the arch of the aorta sharing the general disturbance in position. direction of the arch.

The large branches of the neck may have their usual origin (the highest part of the arch) moved more to the right; or their distance from one another may be increased or diminished. When there is transposition of the arch there is likewise transposition of the branches, the innominate artery going to the left side, and the carotid and sub- Position of the primary branches.

clavian vessels of the right side having separate attachments to the arch.

Their number may be reduced to two, or increased to four, five, or six.

The branches of the arch may likewise be altered in number as well as in position. The most frequent change is the reduction of the arteries to two, as when the left carotid arises from the innominate artery. But the number may be increased to four by the absence of the innominate trunk, and the separate origin of the right carotid and subclavian arteries from the arch. In this last case the right subclavian varies in its position, though commonly it is attached to the arch of the aorta, to the left of the rest. Lastly, there may be five or six primary trunks from the arch, as instanced by the origin from it of the internal and external carotids, in consequence of absence of the trunk common to the two, on one or both sides.

Secondary branches.

Some smaller or secondary arteries take origin occasionally from the arch. The most frequent example of this peculiarity is seen in the origin of the vertebral artery, between either the left carotid and subclavian trunks, or beyond them. Occasionally a thyroid artery (lowest thyroid), or the internal mammary, will be seen to spring from the arch of the aorta.

Innominate artery ends in carotid and subclavian.

The *innominate artery* (brachio-cephalic) is the largest branch of the transverse part of the arch, and arises first in the direction from right to left. It is a thick trunk, about one inch and a half in length, which ascends to the right beneath the sternum, and divides into right carotid and subclavian arteries opposite the articulation between the sternum and the clavicle. The artery is crossed by the left innominate vein, and is covered by the upper piece of the sternum, and by the origin of the sterno-hyoid and thyroid muscles. At first the innominate artery rests on the trachea, but as it ascends it lies on the right of the air tube. On its right side is the right innominate vein, with the phrenic nerve. No lateral branch arises from this artery in the ordinary condition of the vessel.

Length and connections.

Length may be altered, or thyroid branch may arise from it.

Peculiarities.—The length of the artery may exceed two inches, or it may measure only one inch or less: in these different states the place of bifurcation will be altered, being in one case beyond, and in the other below the level of the upper border of the clavicle. A branch to the thyroid body (art. thyroidea ima), or to the thymic body, or to the root of the lung, may arise from the innominate artery.

Left common carotid

Left common carotid artery in the thorax.—The common carotid artery of the left side of the neck springs from the arch

of the aorta, whilst the vessel of the right side begins at the bifurcation of the innominate artery, opposite the sterno-clavicular articulation; and it is longer than the right by the distance between the arch and the top of the sternum.

Artery arises from arch of aorta.

In the thorax, the artery ascends obliquely to the left sterno-clavicular articulation, crossing beneath the left innominate vein, and being placed behind the first piece of the sternum with the attachment of the laryngeal muscles, and the remains of the thymus gland. In that course the subclavian trunk lies at first on the trachea, but it afterwards crosses to the left of that tube, and lies over the œsophagus and the thoracic duct. To its outer side is the left pneumogastric nerve, with one or more cardiac branches of the sympathetic nerve. In the neck, the connections of the vessels of opposite sides are the same (p. 71.).

Connections in the thorax.

Peculiarities. — The most frequent change in the vessel concerns its origin. Thus, this artery is sometimes united with the innominate artery; or, should the innominate artery be absent, the common carotids, right and left, arise usually by one trunk. It seldom changes its relative position with respect to the other branches of the arch.

Peculiarities in its origin.

The *left subclavian artery* arises from the arch of the aorta, and ascends to the lower part of the neck through the upper aperture of the thorax. Beyond the first rib the vessels of opposite sides are alike (p. 63.).

Left subclavian artery.

The left subclavian trunk is directed almost vertically from the arch of the aorta to the inner margin of the first rib. In the thorax the vessel lies deeply, resting first on the œsophagus, and then on the side of the vertebral column, in front of the longus colli muscle; and it is covered by the left pleural bag in all its extent. On its inner side are the trachea and the œsophagus, with the thoracic duct. Somewhat anterior to the level of the artery, though running in the same direction, is the vagus nerve, with some of the cardiac nerves.

Course and connections in the thorax.

Peculiarities. — The left subclavian is subjected less frequently than the other branches of the arch to variations from its ordinary arrangement. Sometimes it arises in common with the left carotid, or it may take origin, though rarely, from a dilatation connected with the remains of the arterial duct. It has been before said that, where there

Variations in its origin not frequent.

is transposition of the viscera, the left subclavian and carotid arise from an innominate trunk; but this is not a constant rule, for the subclavian, in such a condition of the vessels, may be the last on the arch, and cross the front of the spinal column to take its place in the neck.

Right subclavian may arise from the arch.

In some instances the right subclavian arises from the arch of the aorta, and when this peculiarity exists, the vessel may be placed first, second, or third, though most frequently it is last on the arch. To reach the inner margin of the first rib of the right side, when it is last on the arch (most to the left), the artery is directed between the œsophagus and the vertebral column, or it may be, as in one case, between the trachea and the œsophagus. The right subclavian may also be connected with the pouch, or the pervious part of the ductus arteriosus, in the same way as the left subclavian. (See Quain, p. 159.)

Veins of the heart are

VEINS OF THE HEART. — These are, as before said, the superior and the inferior cava, which are the great systemic veins that return impure blood to the right auricle; and the pulmonary veins, that open into the left auricle, and convey to it pure blood from the lungs.

superior cava; which is formed by innominate veins;

The *superior* or *descending cava* is formed by the union of the right and left innominate veins, and conveys to the heart the blood of the head, neck, upper limbs, and thorax. Its origin is on the right side of the arch of the aorta, opposite the interval between the cartilages of the first two ribs. From that spot the large vein descends to the pericardium, perforates the fibrous layer of that bag, about one inch and a half above the heart, and ends in the right auricle. On its outer aspect, the vein is covered by the right pleura, and the phrenic nerve is in contact with it. On the inner side is the ascending part of the arch of the aorta. Behind the vein is the right branch of the pulmonary artery.

ends in heart.

Its branches.

When the cava is about to perforate the pericardium it is joined by the large azygos vein of the thorax. Higher than this spot it receives small veins from the pericardium, and the parts in the mediastinal space; and commonly the right internal mammary vein opens into it.

Innominate veins are right and left.

The *innominate veins* are united inferiorly in the trunk of the descending cava: they are two in number, right and left, and each is formed behind the inner end of the clavicle by the union of the subclavian and internal jugular veins of one side of the neck. The trunks differ in length, direction, and in their connections with the surrounding parts.

How formed.

a. The *right* vein is about one inch and a half long, and descends vertically, on the right side of the innominate artery, to its junction with the vein of the opposite side. On the outer aspect the pleura covers it, and along it the phrenic nerve is placed. Right, an inch and a half long;

b. The *left* vein is twice or three times as long as the right, and is directed obliquely downwards above the level of the arch of the aorta, to join the superior cava. Between its origin and termination the vein crosses behind the sternum, and the remains of the thymus gland; and it lies on the three large branches of the aortic arch, as well as on the several nerves that descend over the arch. left, three times as long and oblique in direction.

The *branches* of these veins are not the same on the two sides. Into the right vein the inferior thyroid branch of the same side opens, and occasionally the right internal mammary vein ends in it. The left innominate vein is joined by the left inferior thyroid, by the internal mammary of the same side, by the left superior intercostal, and by some small thymic and pericardiac veins. Their branches.

Peculiarities. — Sometimes the innominate veins are not united into one, but remain separate, and have distinct openings in the right auricle. When such a variety exists, the right vein takes the course of the upper cava, whilst the left vein descends on the left side of the heart, and opens into the right auricle through the large coronary vein. A cross branch is found connecting the two above the heart. Sometimes they open separately into the heart.

The *inferior* or *ascending cava* enters the right auricle as soon as it has pierced the diaphragm. No branches open into the vein in the thorax. The anatomy of this vein is given with the vessels of the abdomen. Inferior cava.

The *pulmonary veins* are two on each side; they issue from the fissure of the root of the lung, and end in the left auricle; their position to the other vessels of the root has been noticed at p. 307. Four pulmonary veins.

The right veins are longer than the left, and lie beneath the right auricle of the heart. The superior one receives its roots from the upper and middle pulmonic lobes, and the inferior vein is formed by branches of the lower lobe. Right veins longest.

The left veins cross in front of the descending aorta, and spring one from each lobe of the lung. Left.

Their number varies.

Peculiarities. — The number of these veins may be altered; first, by the union of the veins of the left side into one; and, secondly, by the want of union on the right side, from which three trunks result, corresponding to three lobes. But other peculiarities may be found as to number, for six or seven veins have been observed taking both sides together, and a bronchial vein has been found opening into one of the left veins.

NERVES OF THE THORAX.

Nerves of the thorax.

The viscera of the thorax are supplied by the pneumogastric and the sympathetic nerves. Some other nerves (intercostal) are contained in the wall of the thorax, and will be afterwards dissected. In the cavity of the thorax is the phrenic nerve, coursing through it to the diaphragm.

To trace the nerves, particularly vagus.

Dissection.— The phrenic nerve is sufficiently exposed for its examination, but the student should trace the vagus nerve on each side through the cavity of the thorax. Follow the vagus on both sides, behind the root of the lung, and seek some filaments of the gangliated cord of the sympathetic, which come forwards to it. In front of the root the nerve supplies a few pulmonary filaments, especially on the left side. From the root of the lung pursue the vagus along the œsophagus, by raising the lung and removing the pleura.

Phrenic nerve is derived from the cervical plexus,

The PHRENIC NERVE (internal respiratory) is a muscular branch of the cervical plexus to the diaphragm (p. 70.), and passes through the thorax to its distribution. In its course through the thorax, it lies in front of the root of the lung and along the side of the pericardium, with a small companion artery. When near the diaphragm each is divided into branches that perforate the muscle, and are distributed on its under surface. The nerves of opposite sides differ in length, and in their connections above the root of the lung.

and passes through thorax to the diaphragm.

Right nerve above root of lung.

a. The *right* nerve is deeper at first in its position, and is also shorter and straighter than the left. As it enters the chest the nerve crosses behind the subclavian vein, but in front of the internal mammary artery; and it lies afterwards along the right side of the innominate vein and superior cava till it reaches the front of the root of the lung.

Left nerve

b. The *left* nerve has the same position to vessels as the

right when entering the cavity, but it is directed in front of the arch of the aorta to the root of the lung; and, lastly, it makes a curve around the projecting heart. Before reaching the arch of the aorta, the nerve is external to the left common carotid artery, and crosses the left vagus from without inwards, so as to be internal to that nerve on the arch.

above root,

is longer than right.

Branches. — Some small filaments are furnished from the phrenic nerve to the pericardium; and occasionally the nerve is joined near the upper part by a twig from the branch of nerve of the subclavius muscle.

Some offsets.

Internal mammary artery. — A small part of this artery, which furnishes a branch to the diaphragm, has not yet been noticed. This part intervenes between the entrance of the artery into the chest (p. 66.), and its course through the cavity along the side of the sternum (p. 231.). Lying beneath the first rib the vessel winds round the phrenic nerve and the innominate vein to reach the side of the sternum. It gives the following offset: —

Internal mammary artery

winds round aperture of thorax,

The *superior phrenic branch* (comes nervi phrenici) is a very slender artery that accompanies the phrenic nerve to the diaphragm, and is distributed to that muscle, anastomosing therein with the other arteries from the aorta, and the musculo-phrenic branch of the internal mammary.

and gives phrenic branch.

The PNEUMO-GASTRIC NERVE is one of the three trunks composing the eighth cranial nerve (p. 172.). Like the phrenic nerve, each passes through the thorax in its course from the neck to the abdomen. In the lower part of the thorax the nerves resemble one another in their course, for they pass behind the root of the lung, each on its own side, and along the œsophagus to the stomach. But above the root of the lung, the right and left nerves differ as much as the phrenic. Each supplies branches to the viscera, viz. to the heart, the lungs, and the gullet.

Vagus nerve in the thorax corresponds on both sides below root of lung.

a. The *right* nerve is posterior to the left in position. As the nerve appears in the thorax, it lies between the subclavian vein and artery, and sends backwards a recurrent branch round the latter. At first it is directed obliquely backwards, over the side of the trachea, to the interval between that tube and the œsophagus; and thus supported, the nerve reaches the posterior aspect of the root of the

Right vagus above the root of the lung,

and on the back of the œsophagus below root. lung, where it forms the posterior pulmonary plexus. Two large offsets are continued to the œsophagus from the plexus, and unite near the diaphragm into one trunk, which lies behind the gullet, and passes along it to the posterior surface of the stomach.

Left nerve above the root of the lung, *b.* The *left* nerve enters the thorax behind the left innominate vein, and to the outer side of the left common carotid artery. Lying between the left subclavian and common carotid arteries, the nerve courses over the arch of the aorta, and beneath the root of the lung, and forms there a

and on the front of the œsophagus. larger plexus than on the right side. From the pulmonic plexus one or two branches pass to the front of the œsophagus, and join with the corresponding branches of the right nerve in a plexus on that tube. Finally, the divisions of the nerve are collected into one trunk, which is continued on the front of the œsophagus to the anterior part of the stomach.

Branches are, The *branches* of the pneumo-gastric nerve in the thorax are the following:—

recurrent laryngeal in the thorax; 1. The *recurrent* or *inferior laryngeal* nerve is the first branch in the thorax. Arising on the right side on a level with the subclavian artery, and on the left at the lower border of the arch of the aorta, the nerve bends backwards to the trachea, along which it ascends to the larynx. On each side this branch is freely connected with the cardiac branches of the sympathetic nerve, especially on the left side beneath the arch of the aorta.

cardiac branches in the thorax; 2. *Cardiac branches* (thoracic).—Besides the cardiac branches furnished by the vagus in the neck, there are other offsets in front of the trachea to communicate with the cardiac plexus. These branches come from the trunk of nerve on the right side, but they are supplied by the recurrent nerve on the left side.

lower cardiac branch of the neck; The termination of the lower *cervical cardiac* branch of each nerve (p. 106.) may now be seen. The branch of the right vagus lies by the side of the innominate artery, and joins a cardiac nerve of the sympathetic; but the branch of the left vagus crosses over the arch of the aorta, and ends in the superficial cardiac plexus.

Pulmonary branches. 3. *Pulmonary branches.*—There are two sets of branches for the lung, one to the anterior and the other to the posterior aspect of the root.

Small anterior. *a.* The anterior branches are two or three in number, and of small size, and communicating with filaments of the sympathetic

on the pulmonary artery, form the anterior pulmonary plexus. These nerves are best seen on the left side.

Large posterior form a plexus.

b. The posterior branches are the largest and much the most numerous, and are obtained by the splitting of the trunk of the nerve after it has become flattened. Forming a plexiform arrangement (posterior pulmonary plexus) behind the root of the lung, these nerves are joined by filaments from the third and fourth ganglia of the knotted cord of the sympathetic, and are conveyed into the interior of the lung on the divisions of the air tube.

Œsophageal branches form a plexus.

4. *Œsophageal branches* are furnished to the gullet all along the thorax, but in greatest abundance in the lower half. Below the root of the lung the branches of the pneumo-gastric nerves surround the œsophagus with a network, which has been named *plexus gulæ.*

Part of the sympathetic in thorax consists of

SYMPATHETIC NERVE. — In the thorax the sympathetic nerve consists, as in the abdomen, of a knotted cord along each side of the spinal column, which communicates with the spinal nerves: and of a large prevertebral or cardiac plexus, which distributes branches to the viscera, viz. to the heart and the lungs.

a gangliated cord,

The gangliated cord will be exposed in a future stage of the dissection, after the heart and the lungs are removed.

and a central cardiac plexus.

The cardiac plexus lies at the base of the heart, around the great bloodvessels. A part of this network, the superficial cardiac plexus, has been already described (p. 313.). The remaining part, or the deep cardiac plexus, will be exposed beneath the arch of the aorta by the following dissection: —

Dissection of the plexus.

Dissection. — The cardiac plexus has been interfered with by the previous examination of the heart, but by following the directions now given the student will obtain a knowledge of the disposition of the nerves, and will be able to make a complete dissection of them when the opportunity offers.

To find the right part.

Cut across the arch of the aorta with care, close above the pulmonary artery, and draw the arch well over to the left side: next divide the descending cava, above the entrance of the vena azygos, and throw down the lower part. By the removal of some cellular membrane and lymphatic glands, the right part of the plexus, in which the cardiac branches of the sympathetic and pneumo-gastric nerves of the right side are united, will be found in front of

the trachea, above the right branch of the pulmonary artery. The offsets to the heart should be followed downwards on the trunk of the pulmonary artery, and those to the lung should be traced along the branch of the artery.

To expose the left part. To expose the part of the plexus into which the branches of the sympathetic and vagus nerves of the left side of the body enter, cut through the arch a second time, to the left of the junction of the ligamentum arteriosum with it, and divide that ligament, so as to allow the transverse part of the arch to be turned upwards with the great vessels attached to it. The lymphatic glands and the cellular tissue are to be cleared away as on the opposite side to expose the nerves. Afterwards follow downwards the nerves to the heart, chiefly to the posterior coronary plexus.

Nerves entering the deep cardiac plexus. In the *deep cardiac plexus* are united the several cardiac nerves derived from the ganglia of the sympathetic in the neck, except the highest nerve of the left side; together with all the cardiac branches of the vagus nerve both in the neck and the chest, with the exception of the lowest cervical cardiac branch of the left side. Its situation; This large centre is situate between the trachea and the arch of the aorta, above the branches of the pulmonary artery; and from it nerves are is formed of two parts, right and left. furnished to the heart and the lungs. The several nerves entering the plexus are not intermingled in a ganglionic mass in front of the trachea, but those of the right side unite together on the same side of the trachea, and those of the left half of the neck have a like disposition on their side of the air tube.

Right part how formed. *a*. The *right* part of the plexus is above the right branch of the pulmonary artery, and receives the nerves of the right side, viz. the cardiac nerves of the sympathetic in the neck, the cardiac branches of the trunk of the vagus, both in the neck and chest, and the cardiac offsets of its recurrent branch. Branches are distributed to the heart The branches of this part of the plexus are distributed mostly to the right side of the heart. From its lower end cardiac nerves pass downwards before and behind the right branch of the pulmonary artery. Those in front of that vessel run on the trunk of the pulmonary artery nearly to the heart, where they send a few twigs behind the vessel, to join the plexus on the posterior coronary artery; and, lastly, they by the anterior coronary plexus. appear between the aorta and the pulmonary artery, to end in the anterior coronary plexus (p. 313.). The other nerves, those that

are behind the branch of the pulmonary artery, supply the right auricle of the heart. Offsets are also sent laterally on the branch of that artery to the nerves of the root of the lung. A few go to root of lung.

b. The *left* half of the plexus is close to the ligamentum arteriosum, and rather on the left of the trachea. In it are collected the cardiac nerves of the sympathetic cord of the left side of the neck, except the highest, which goes to the superficial cardiac plexus; also the numerous and large branches of the left recurrent nerve of the vagus. Nerves descend from it around the left branch of the pulmonary artery to the trunk of that vessel, on which they are continued to the heart; and after supplying nerves to the left auricle, they terminate in the bundle of nerves of the posterior coronary plexus (p. 313.). A considerable offset is directed forwards by the side of the ligamentum arteriosum, to join the superficial cardiac plexus; and some nerves reach the pulmonary plexus by passing along the branch of the artery to the lung. Left part; nerves entering it. Offsets descend to left coronary plexus and to root of lung.

The *cardiac branches* of the gangliated cord of the sympathetic nerve in the neck (p. 110.) are now seen at their termination in the thorax. The nerves enter the chest on each side, over or beneath the subclavian artery, and join in the deep cardiac plexus, with one exception (left superficial cardiac). Other cardiac nerves from the neck.

a. On the right side.—Though usually three in number, there may be but two cardiac nerves on this side, for the highest, or superficial nerve is sometimes blended with one of the other two. The middle and inferior nerves pass beneath the subclavian artery to the right half of the deep cardiac plexus. All three communicate with the branches of the recurrent laryngeal nerve of the vagus at the root of the neck, or in the upper part of the thorax, as well as with one another. Three on the right side enter deep plexus.

b. On the left side the superficial or highest cardiac nerve passes for the most part over the arch of the aorta, and ends in the superficial cardiac plexus, but it may give a branch beneath the arch to the deep plexus. Only one other large nerve may be seen entering the left side of the deep cardiac plexus, for oftentimes the middle cardiac throws itself into the lower cardiac nerve. Three on left; one enters superficial, others deep plexus.

THE TRACHEA AND THE LUNG.

Dissection.—To expose the bronchi, or the divisions of the air tube in the root of the lung, it will be necessary to remove the To expose the trachea

and its divisions. pulmonary artery and its branches, together with the pulmonary veins. When the transverse part of the arch of the aorta, which has been already cut through, is turned to one side, the dissector will be able to clear away the bronchial glands, the nerves, and the cellular membrane from the part of the trachea in the thorax, and from its branches of bifurcation.

Trachea lies in the neck, The TRACHEA, or the air tube, reaches from the larynx to the lungs, and lies on the front of the spinal column. The tube begins at the lower part of the larynx, opposite the fifth cervical vertebra, and ends at the third dorsal vertebra by dividing into two pieces (bronchi), one for each lung. and in the thorax, where it ends in bronchi. Its connections in the neck are described at p. 115., and its structure at p. 153. The part in the thorax remains to be studied.

Its connections in the thorax. In the thorax the trachea is situate with the great vessels between the pleural bags. There it is covered by the arch of the aorta, by the innominate and left carotid arteries, and by the cardiac plexus of nerves; and superficial to the last arteries is the left innominate vein. Behind the air tube is the œsophagus, which is slightly inclined to the left near the arch of the aorta. On the right side is the vagus, together with the innominate artery, for a short distance, after it has passed over the trachea; and on the left side is the vagus with its recurrent branch.

Bronchi lie in the roots of the lungs; The divisions of the air tube, or the *bronchi*, are contained in the root of the lung, where they are surrounded by vessels, glands, and nerves. Near the lung each is divided into as many primary branches as there are lobes to that organ. Their position behind the other pulmonary vessels has been described at page 307, but the peculiarities of each are now to be noticed. are like the trachea in form. In their structure and form the bronchi resemble the windpipe, for they are round and cartilaginous in front, but flat, and muscular and membranous behind.

The right differs from the left branch in length, The *right* branch is about an inch in length, and is larger than the left; it passes outwards almost horizontally on a level with the fourth dorsal vertebra, and is placed above the right pulmonary artery: the vena azygos arches over it. The *left* branch is about two inches long. It is directed

obliquely downwards through the arch of the aorta, and joins the root of the left lung, at a spot a vertebra lower than on the opposite side. In this course the tube lies on the œsophagus and the thoracic duct, and on the descending aorta; it is at first below the level of the corresponding pulmonary artery. course, and connections.

Dissection. — Remove the lungs from the body by cutting through the vessels of the root. Take away, next, the remains of the heart and pericardium, after dividing the inferior cava and detaching the pericardium from the surface of the diaphragm. Whilst doing this, some care should be taken by the dissector not to injure the parts contained in the interpleural space in front of the spine. After the lungs are detached, their characters and structure may be examined. Remove the lungs to examine them.

Physical Characters of the Lung. — The surface of the lung is smooth and shining, because of the pleural investment. Through the serous covering the mass of the lung may be seen to be divided by cellular septa and by dark spots, or sometimes lines, into small irregularly sized pieces or lobules. On looking closely at the pulmonary substance, especially at a thin margin, the texture will be perceived to be spongy, or composed of minute cells. Surface is smooth; is marked by lobules and small cells.

The tint of the lung varies with age. In infancy the colour is a pale red; but in the adult the texture becomes greyish in colour, and presents here and there dark grey spots or lines, whose colour deepens with increasing age, and becomes even black in old people. From the position of the body after death the colour of the posterior border may be of a bluish black shade. Colour varies with age. accidental colour.

To the touch the lung is soft and yielding, and on cutting into it the pulmonary substance will be found to be porous and spongy; but the lung which is deprived of its air by pressure has a tough leathery feel. In the ordinary condition of the lung slight pressure with the thumb and finger drives the air from its containing cells through the pulmonary structure, and produces the noise known as crepitation. If the lung contains serum, a frothy red fluid will run out on a section being made. The texture of the lung is very elastic; this elasticity causing the organ both to Consistence and elasticity of the pulmonary texture,

diminish greatly when the thorax is opened, and to expel air that may be blown into it.

Specific gravity, The specific gravity of the lung varies with the conditions of dilatation and collapse, or of infiltration with fluid. When the pulmonary tissue is free from fluid and filled with air it floats in water, but when it is quite deprived of air it is slightly heavier than water, and sinks in that fluid.

and weight of the lung. The weight of the lung is influenced greatly by the quantity of fluid or other material contained in its texture; ordinarily it varies from eighteen to twenty-one ounces, and the right lung is about two ounces heavier than the left. In the male the lungs are larger, and slightly heavier than in the female.

Follow bronchi and vessels into the lung. *Dissection.* — By tracing the large branches of the bronchi and the bloodvessels and nerves into the lung, their mode of branching will be apparent; and by inflating a part of the lung, the cellular structure may be seen. But the arrangement of the different vessels will not be ascertained without minute injection, and the use of a microscope.

Outline of the elements of the lung. STRUCTURE OF THE LUNG. — The spongy pulmonary structure consists of minute cells, in which the smallest branches of the air tube terminate; and the mass of the lung is formed by the aggregation of the cells into small groups or lobules, and into larger masses or lobes. Each lobule is distinct from the surrounding ones, and is furnished with its air tube and nerves, and with its own set of vessels necessary for both its function and nutrition. The constituents of the lung are united by a serous covering, which is prolonged continuously over the surface, and by a subserous cellular coat, which penetrates into the mass, subdividing it into pieces. These several parts are examined more in detail below.

Serous and subserous coverings. *Serous and subserous coverings.* — The coat derived from the pleura is thin and transparent, and forms an entire capsule for the lung, except at the root, where the vessels enter. The subserous cellular layer contains fibres of elastic tissue, and not only covers the surface, but extends into the interior, establishing the division of the mass into lobules: where it separates the lobules it is named interlobular cellular tissue, and is there free from fat.

Form of the air cells; position on air tubes. Size. Structure.

The *air cells* are the little sacs or dilatations in which the smallest branches of the air tube terminate. They are polyhedral in form, except on the surface, adapting themselves thereby to the neighbouring cells, and are distinct one from another, save through the channel of the air passage. The cells are clustered around the smallest divisions of the air tubes, and are situate both along the sides and at the extremity of the tube, with which they communicate by large orifices. In size, these small cells vary from $\frac{1}{200}$ to $\frac{1}{70}$th of an inch across, but they are larger on the surface and at the edges than in the deeper parts of the lung. The cell wall is formed by scattered fibres of elastic tissue, and is lined by a transparent mucous membrane possessing scaly epithelium. Beneath the mucous lining is a network of the pulmonary vessels.

Lobules how formed. Lobes.

Lobules and lobes. — A lobule is a cluster of air cells around the terminal divisions of a lobular branch of the air tube. Varying in size and shape, each lobule is invested by cellular tissue, and possesses its own branch of the air tube, as well as distinct branches of vessels and nerves. The larger masses of the lung, viz. lobes, are produced by the aggregation of lobules.

Divisions of the bronchi in the lung till they end in cells.

Bronchial divisions in the lung. — When a bronchus is followed into the pulmonary structure, it is found to divide generally in a binary order, and to diminish in size at each subdivision, until one offset appertains to a lobule, of which it forms the *lobular* bronchial tube. In the lobule, again, the tube still subdivides, according to the size, until the final ramifications have but a diameter of $\frac{1}{50}$ to $\frac{1}{30}$th of an inch. When this last degree of diminution is arrived at, the tubes give origin to the air cells, as explained above.

Difference in large and small tubes in structure and in form.

In the larger bronchial branches the constituent parts are the same as in the trachea, only they are somewhat differently arranged; but in the smallest divisions, and in the air cells, some of the common structures are absent. Further, the larger bronchial divisions in the lung are round instead of being hemispherical, as in the trachea; but the smallest (from which the cells spring) are irregular in shape, appearing to be spaces amongst the cells rather than tubes with continuous walls.

Constituents of the air tube in the lung. Pieces of cartilage.

The modifications which the elementary pieces of the air tube undergo in the bronchial divisions and in the air cells are the following:—The *pieces of cartilage*, which are circularly arranged in the trachea, become broken up in the bronchial divisions, and scattered over the wall as irregular fragments. Becoming thinner and smaller as the subdivision of the air tube proceeds, they at last disappear, and are absent from the terminal branches. The

Fibrous and elastic tissue. *fibrous* and *elastic* tissues of the bronchial tubes are continued even to the air cells, but in the small cell-bearing branches, the bundles of elastic tissue are diffused, and the two textures, much diminished in strength, are blended together to form the parietal structure. Some fibres of the elastic tissue are continued to the air cells. Muscular fibres. The *muscular fibres* of the back of the trachea are diffused over the surface of the bronchial divisions, and extend along the air tube beyond the limit of the pieces of cartilage, but they cease where the cells begin to be formed. Mucous membrane. The *mucous membrane* becomes thinner as it extends onwards along the air tube, and is finally continued to the cells, where it is transparent. Its ciliated columnar epithelium is changed for scaly or pavemental in the finest bronchial divisions, and in the air cells.

Vessels of the lung are functional and nutrient, viz. *Vessels of the lung.* — Two sets of vessels are furnished to the lung, one being concerned in its function, the other in its nutrition. The vessels that convey blood to the lung to be aerated, or that carry the same away after it has been subjected to the respiratory process, are named pulmonary; whilst the vessels connected with the nutrition of the structure are called bronchial.

pulmonary artery *a.* The *pulmonary artery*, after entering the lung, divides like the bronchus which it accompanies: and its last branches are furnished to the lobules. In the lobule the arterial branch is minutely subdivided and its ramifications end in a capillary network in the wall of the air cells, beneath the mucous lining. The vascular circle around one cell communicates with the contiguous ones. and vein; The *pulmonary veins* begin in the arterial network before mentioned, and the twigs issuing from the several lobules are united in larger tubes, that accompany the arteries from the lung. Although the small lobular branches of the arteries remain separate from one another, the corresponding veins anastomose together.

and bronchial artery *b.* The *bronchial arteries* enter the lung on the air tube, and supply offsets to those tubes and the contiguous bronchial glands, to the large bloodvessels, and to the interlobular cellular tissue of the lung. and vein. The *bronchial vein* begins by roots corresponding to the branches of the artery, except the smallest divisions of the air tubes, the capillaries of which communicate with the pulmonary vessels — most probably the arteries.

Nerves. *Nerves and lymphatics.* — The lung receives *nerves* from the vagus and the sympathetic, and the offsets follow the divisions of the air tube. Lymphatics. The *lymphatics* of the lung are both superficial and deep, and enter the bronchial glands at the root of the lung.

PARTS IN FRONT OF THE SPINE AND THE CORD OF THE SYMPATHETIC.

In front of the spinal column are the several parts enumerated as lying in the interpleural space of the posterior part of the mediastinum, viz. the aorta, vena azygos, thoracic duct, and œsophagus.

Dissection. — First find the small thoracic duct near the diaphragm, and on the right of the aorta, by cutting through the pleura that covers it. This slender vessel may be injected with tallow. Afterwards clear away the cellular membrane from the different parts before mentioned, and follow upwards the thoracic duct beneath the arch of the aorta, till it leaves the upper aperture of the thorax. A small azygos vein, on the left of the aorta, should likewise be dissected. Raise the pleura from the inner surface of the ribs, and the gangliated cord of the sympathetic nerve will be seen lying along the side of the spinal column over the heads of the ribs. Branches should be followed outwards from the ganglia to the intercostal nerves, and other branches should be traced over the bodies of the vertebræ to form the three trunks of the splanchnic nerves. Dissection of the parts above mentioned.

The THORACIC AORTA is the part of the great systemic vessel which is above the diaphragm. Its extent is from the lower border of the third dorsal vertebra (the left side), where the arch ceases, to the front of the last dorsal vertebra. Thoracic aorta. Extent, Contained in the interpleural space, in front of the spine, the vessel is rather arched in its course, lying at its upper part on the left, but at its lower part in front of the spine, so that the curve resulting therefrom has its convexity turned to the left. course, In all its length the aorta is covered by the left pleura; and in front of it is the root of the left lung with the pericardium. and connection. To its right side are the œsophagus and the thoracic duct, but near the diaphragm the former is placed over the aorta. Beneath the vessel are the vertebræ and the smaller azygos vein.

The *branches* of the vessel are distributed to the surrounding parts, and are named from their destination, viz. Branches.

bronchial, pericardial, œsophageal, mediastinal, and intercostal.

Arteries of the lung. 1. The *bronchial arteries* supply the structure of the lungs, and arise from the front of the aorta, but their number and place of origin are liable to vary.

One right, *a.* The artery of the right lung arises either in common with one of the left bronchial arteries (superior), or from the first intercostal artery of the right side.

two left. *b.* For the left lung there are two arteries (superior and inferior), that arise from the aorta at a distance one from another.

Distribution. These vessels adhere to the posterior part of the bronchial tubes, and so enter the interior of the lung, in which they ramify; they give some twigs to the bronchial glands and the œsophagus.

Vein of the lung. *Bronchial veins.*—One vein issues from the root of each lung, to end in the following manner:—the right vein joins the larger azygos vein, and the left ends in the superior intercostal vein of the same side.

Pericardial branches. 2. The *pericardial branches* are some irregular twigs that are furnished to the posterior part of the cardiac covering.

Œsophageal branches. 3. *Œsophageal branches* arise at different parts of the aorta, and are four or five in number. Ramifying in the structure of the gullet, these vessels anastomose with one another; above, they communicate with branches of the inferior thyroid artery near the larynx, and below with twigs of the coronary artery of the stomach.

Mediastinal branches. 4. Small *mediastinal branches* (posterior) supply the cellular tissue and the glands in the posterior part of the interpleural space.

Intercostal arteries. 5. The *intercostal arteries* are commonly ten or nine in number on each side, and are furnished to the same number of the lower

Number. intercostal spaces. To the other one or two upper spaces branches are supplied from the intercostal artery of the subclavian trunk.

Direction to the intercostal spaces. These small vessels arise from the posterior part of the aorta, and run outwards on the vertebræ, and beneath the cord of the sympathetic nerve, to the intercostal spaces, where each divides into an anterior and a posterior branch. In this course the upper branches are somewhat oblique, and the lower ones transverse. As the

Right, longest. aorta lies on the left of the spine, the right branches are the longest and pass beneath the œsophagus, the thoracic duct, and the vena azygos major; they supply many twigs to the bodies of the vertebræ on which they lie.

The anterior branch *a.* The *anterior branch* is the continuation of the common trunk in direction and size. At first the artery lies in the centre of the inter-

costal space, beneath the pleura and a fascia prolonged backwards from the internal intercostal muscle, resting here on the external intercostal layer of muscle. But it ascends to the lower border of the rib above, near the angle, and then continues onwards between the intercostal strata nearly to the anterior third of the space, where it ends in two branches that anastomose with the intercostal arteries of the internal mammary (p. 232.). Accompanying the artery are the intercostal nerve and vein, the vein being commonly highest, the nerve lowest, and the artery between the two; but in the upper spaces the nerve is at first above the artery, though it soon takes its place below that vessel. Branches are furnished to the layers of intercostal muscles and to the ribs: about the centre (from front to back) of the intercostal space a superficial twig accompanies the cutaneous nerve.

occupies intercostal space

with nerve and vein.

Offsets.

The upper artery of the set anastomoses with the superior intercostal branch of the subclavian artery, and the lower ones enter the abdominal wall below the true ribs, and anastomose in it with the arteries of that part.

Anastomoses.

b. The *posterior branch* turns backwards between the vertebra and the ascending costo-transverse ligament, and is distributed in the back. As it passes by the intervertebral foramen it furnishes a small spinal branch to the vertebræ and the spinal cord. — (See VESSELS OF THE SPINAL CORD.)

Posterior branch turns to the back.

The *intercostal vein* closely resembles the artery in its course and branching. Near the head of the rib it receives a contributing dorsal branch, and then joins the azygos vein.

Intercostal vein

The *superior intercostal artery* of the subclavian trunk is referred to in the dissection of the neck (p. 67.). Descending over the neck of the first rib, external to the ganglion of the sympathetic, the artery supplies a branch to the first intercostal space: continuing to the second space, which it may supply in like manner, it ends by anastomosing with the upper aortic intercostal branch. Each intercostal branch from it divides into an anterior and posterior branch of distribution like the aortic arteries.

Superior intercostal artery is derived from subclavian.

Supplies one or two spaces.

The *vein* corresponding to the artery is differently disposed on the two sides. On the right side it opens into the subclavian vein. On the left side the superior intercostal vein is formed by branches of the two or three highest spaces; it is joined by the left bronchial vein, and ends in the left innominate vein, after crossing the arch of the aorta.

The vein on the right and on left side.

The *prevertebral* or *azygos veins* are two in number, large and small, and receive branches corresponding to the offsets furnished by the thoracic aorta. Moreover, by

Two azygos veins.

means of the larger vein, the inferior cava communicates with the superior, so that blood may reach the heart from the lower part of the body even if the lower cava should be obliterated.

Small, or left, begins in abdomen, ends in larger azygos. Branches

a. The *smaller* or left *azygos vein* (inferior) begins in the abdomen, in the lumbar veins of the left side of the vertebral column. Having entered the thorax along with the aorta, or through the crus of the diaphragm, the vein ascends on the left of the aorta as high as the seventh or eighth dorsal vertebra, and then crosses beneath that vessel and the thoracic duct to end in the larger or right vein. It receives the four or five lower intercostal veins of the left side, and some œsophageal and mediastinal veins.

There may be another azygos vein.

Most frequently there is a second left azygos vein (superior Breschet), which is formed by the veins of the spaces between the superior intercostal vein and the highest branch of the small azygos vein. Receiving three or four branches, the trunk either joins the lower azygos, or crosses the spine to open separately into the larger vein.

Large or right azygos is on right side of spine, and joins superior cava.

b. The *larger* or right *azygos vein* begins in the lumbar veins on the right side of the spine, and its origin is described with the vessels of the abdomen. It enters the thorax through the aortic opening of the diaphragm, and ascends over the right intercostal arteries and the bodies of the vertebræ, lying on the right side of the thoracic duct. Opposite the third intercostal space the vein arches forwards above the root of the right lung, to join the superior cava as this vessel enters the pericardium.

Branches joining it.

In this vein are collected the intercostal veins of the right side below the upper two spaces; some of the veins of the left side of the thorax, through the left azygos veins; some œsophageal, mediastinal, and vertebral veins; and the right bronchial vein. This vessel is not provided with valves, so that the intraspinal and intercostal veins may be injected through it.

Œsophagus is partly in neck

The ŒSOPHAGUS is a hollow muscular tube which extends from the pharynx to the stomach. The cervical part of the tube is described at page 115., and the thoracic part is now to be examined.

and

Entering the thorax rather to the left of the middle line,

the gullet is directed inwards beneath the arch of the aorta, and reaches the centre of the spine about the fourth or fifth dorsal vertebra. From that spot it is continued through the interpleural space superficial to the other parts therein, and on the right of the aorta; but at the lower part of the thorax, the gullet is again inclined to the left, over the aorta, to gain the œsophageal opening of the diaphragm. As far as the arch of the aorta the œsophagus lies beneath the trachea, though it is inclined somewhat to the left of the air tube, and is covered by the origin of the subclavian artery. Beyond the arch it is crossed by the left bronchus, and is beneath the pericardium, which conceals it down to the diaphragm. At the upper part of the thorax the œsophagus will be found to rest on the longus colli muscle and the vertebræ, but below the arch of the aorta it is separated from the spine by the intercostal vessels, and lastly it lies on the lower part of the aorta. Being partly covered by the pleura on each side, the tube lies between the aorta and the vena azygos, below the arch, the former being to the left. Below the situation of the bronchus the pneumo-gastric nerves surround the œsophagus with their branches, and above the same spot the thoracic duct will be found to the left of the tube.

partly in the thorax, where it lies in front of the spine, to pass through diaphragm.

Parts covering and beneath it,

and on the sides.

Structure.—If a piece of the middle of the gullet is removed and distended with cotton wool, it will be found to consist of a muscular, a cellular, and a mucous coat.

Three coats are in it.

a. The *muscular coat* is thick and strong, and consists of two layers of fibres, the external being longitudinal, and the internal circular in direction, like the muscular tunic of the other parts of the alimentary tube. At the upper part of the œsophagus the fibres are red, and have the striped character; but below they are paler, and are mostly of the unstriped kind.

A muscular coat

The *external layer* is formed of parallel longitudinal fibres, which form an entire covering, and end below on the stomach. The fibres begin by longitudinal bands opposite the cricoid cartilage (p. 125.).

of external longitudinal

The *internal layer* of circular fibres is continuous above with the fibres of the pharynx; these are more oblique at the middle than at either end of the œsophagus.

and internal circular fibres.

b The *cellular layer* lies between the muscular and mucous coats, and attaches one to the other loosely.

Cellular coat.

Mucous coat.

c. The *mucous coat* or lining will be seen on cutting open the tube to be pale in colour, and of some thickness. It is very loosely connected with the muscular coat, and is thrown into longitudinal folds when the œsophagus is contracted. Lining the interior is a layer of scaly epithelium, and the surface is studded here and there with minute papillæ.

Some glands.

Some small compound glands (œsophageal) are found at the lower part of the gullet.

In the thorax, lymphatic glands and duct.

LYMPHATICS OF THE THORAX. — In the thorax there are lymphatic vessels both of the wall and of the viscera, which enter collections of glands in certain positions, and end in either the one or the other of the two lymphatic ducts. Besides these the large thoracic duct traverses the thorax in its course from the abdomen to the neck.

Several sets of glands, into which the lymphatics are collected.

a. Lymphatic glands.—Along the course of the internal mammary artery is a chain of *sternal* or mediastinal glands, which receive lymphatics from the front of the chest, the thymus gland, the pericardium, and the upper surfaces of the diaphragm and liver. On each side of the spine, near the heads of the ribs as well as between the intercostal muscles, is a set of *intercostal* glands that receive the lymphatics of the posterior wall of the thorax. At the root of and along the trachea are numerous *bronchial* glands, through which the lymphatics of the lung pass. And beneath the arch of the aorta are a few *cardiac* glands, which receive the lymphatics of the heart. Along the side of the aorta and the œsophagus is a chain of *œsophageal* glands, which are joined by the lymphatics of the œsophagus, and communicate with those of the lungs.

Thoracic duct

begins in the abdomen and ends in neck.

Connections in the thorax.

b. The *thoracic duct* is the great channel by which the lymphatic and lacteal fluid of the lower half of the body and the left part of the upper half is conveyed to the blood. The duct begins in the abdomen in an enlargement (chyli receptaculum), and ends in the left subclavian vein of the neck. It is from eighteen to twenty inches in length, and is contained in the thorax, except at its origin and termination; and it has the undermentioned connections. Entering the cavity to the right side of the aorta and through the same opening, the duct ascends on the right of that

vessel, between it and the vena azygos, as high as the arch. Opposite the second dorsal vertebra the duct passes beneath the arch of the aorta and the left subclavian artery, and is applied to the left side of the œsophagus, which conducts it to the neck. Lastly, at the lower part of the neck, the duct arches outwards, as before described (p. 113.), to open into the left subclavian vein. In its course the tube is oftentimes divided in two, which unite again; and near its termination it is generally branched in the same way. It is provided with valves, like a vein, at intervals, and these are in greater number at the upper than at the lower part. Occasionally the duct may be found on the left instead of the right side of the aorta.

May be divided.

Is furnished with valves.

In the thorax the duct receives the lymphatics of the left half of the wall of the cavity, viz. from the sternal and intercostal glands; also the lymphatics of the left lung, of the left side of the heart, and of the trachea, and the œsophagus.

Receives lymphatics.

c. The *right lymphatic* duct, though not in the thorax, is mainly formed by the large branches received from the viscera of the cavity. It is a short trunk at the lower part of the neck, which is about half an inch in length, and opens into the angle of union of the subclavian and jugular veins of the same side. Its opening is guarded by valves.

Right duct is in the neck.

Into this trunk the lymphatics of the right upper limb and right side of the head and neck pour their contents. In addition, the lymphatics of the right side of the chest, of the right lung, of the right side of the heart, and some from the right lobe of the liver, after passing through their respective glands, unite into a few large trunks that ascend beneath the innominate vein to reach the duct in the neck.

It receives lymphatics of the arm and of the thorax.

Cord of the Sympathetic Nerve. — The thoracic part of the gangliated cord of the sympathetic lies by the side of the spinal column, over the heads of the ribs and the intercostal vessels. The ganglia present on it are usually twelve, one being opposite each dorsal nerve, but this number varies much: of these, the upper one is the largest; and the last two are rather anterior to the line of the others, being situate on the side of the bodies of the corresponding vertebræ. In the chest the sympathetic nerve is covered by

Thoracic cord of sympathetic has twelve ganglia,

and is covered by pleura. the pleura, and it is continuous above and below with the cord in the neck and the abdomen.

Branches Each ganglion furnishes external branches of communication with the spinal nerves, and internal or visceral branches.

to join the spinal nerves *Connecting branches.* — Two offsets pass outwards from each ganglion to join a spinal nerve (intercostal). In the branches of communication both white and sympathetic nerve fibres are combined.

to supply viscera. The *internal branches* differ in size and distribution, according as they are derived from the upper or the lower six ganglia.

In the upper six ganglia offsets are small. *a.* The *branches* of the *upper six* are very small, and are distributed to the aorta, and the vertebræ and their ligaments. Mr. Swan describes a plexus in front of the spine as formed by the union of the branches of opposite sides. From the third and fourth ganglia offsets enter the posterior pulmonary plexus.

In the lower six, large and white, and form three nerves. *b.* The *branches* of the *lower six* ganglia are larger and much whiter than the others, and are united together to form some visceral nerves of the abdomen (splanchnic). These splanchnic nerves are three in number (large, small, and smallest), and pierce the diaphragm to end in the solar or the renal plexus.

Great splanchnic, 1. The *great splanchnic nerve* is a large white cord, which arises by roots apparently from only four or five ganglia (sixth to the tenth), but its fibres may be traced upwards on the knotted cord as high as the third ganglion. The nerve descends on the bodies which ends in semilunar ganglion. of the vertebræ, pierces the fibres of the crus of the diaphragm, and ends in the semilunar ganglion of the abdomen.—(See NERVES OF THE ABDOMEN.)

At the lower part of the thorax the nerve may be divided into large bundles, and it may present a ganglion, or more than one on its different bundles.

Small splanchnic 2. The *small splanchnic nerve* is formed by roots from the tenth and eleventh ganglia, or their intervening cord. In the thorax it communicates sometimes with the great splanchnic nerve, and joins cœliac plexus. is transmitted inferiorly through the crus of the diaphragm, to enter the part of the solar plexus by the side of the cœliac artery.

Smallest splanchnic ends in renal plexus. 3. The *smallest splanchnic nerve* begins in the last ganglion, and accompanies the other nerves through the diaphragm. In the abdomen it ends in the renal plexus. When this nerve is absent, its place is taken by a branch of the preceding nerve.

PARIETES OF THE THORAX.

Between the ribs in the wall of the thorax are the two layers of intercostal muscles, which enclose the intercostal nerves and arteries. At the base of the thorax the diaphragm is to be examined in part, as it forms the boundary in this direction; and at the apex of the cavity the relative situation of the parts contained in the upper aperture is to be studied.

Soft parts bounding the thorax, and contained in apex.

INTERCOSTAL MUSCLES. — The anterior part of these muscles has been described with the wall of the thorax in the dissection of the upper limb (p. 229.). The posterior part of the same muscles is now to be examined from the inner side.

Intercostal muscles.

The *internal intercostal muscle* is fixed to the inner margin of the ribs bounding the intercostal space. Beginning at the sternum, it reaches backwards only to the angle of the ribs in the upper spaces, but in the lower spaces the muscular fibres are continued nearly to the head of the rib. Where the muscle ceases, a thin fascia is prolonged from it to the spine. The inner aspect is lined by the pleura, and the opposite surface is in contact with the intercostal nerve and vessels.

Inner layer reaches angle or head of the rib.

Connections.

External intercostal muscle. — Between the posterior border of the internal muscle and the spine, when the fascia before referred to is removed, the external intercostal muscle will be seen. Its attachments above and below are to the margins of two contiguous ribs, and its fibres cross those of the internal muscular layer. Whilst this muscle extends backwards to the spinal column, it does not reach farther forwards than the cartilages of the ribs.

Outer layer extends back to head of the rib.

Dissection.—In a few spaces cut through the internal intercostal muscle, and trace outwards the intercostal nerve and artery.

Trace nerves.

The INTERCOSTAL NERVES are the anterior divisions of the dorsal nerves. In their distribution these nerves differ from the other spinal nerves of the body, inasmuch as they course forwards almost horizontally to the middle line, with-

Intercostal nerves are not joined in a plexus.

out being united together in a plexus. Twelve in number, they occupy the intercostal spaces, except the last, which is below the last rib. There is the following difference between the upper and lower nerves, viz. that the upper six lie between the ribs in all their extent, and are confined to the wall of the thorax, whilst the lower six enter the abdominal wall where the ribs cease in front.

Upper six are in the spaces; lower six leave them in front.

Connections with muscles;

At the posterior part of the chest the nerves are seen to lie at first between the pleura and the external intercostal muscle, with an artery and vein; but they soon enter between the two layers of the intercostal muscles, and extend forwards to the middle line of the body, as before said. Near the head of the rib each nerve is joined by filaments from the sympathetic; and in its course it supplies branches to the intercostal muscles and the ribs, as well as cutaneous offsets to the surface, which are described in the dissection of the upper limb (p. 216.), and of the wall of the abdomen.

with the sympathetic

Offsets.

Exceptions in two first.

There are some exceptions in the first and second nerves to the general arrangement which has been above specified.

First nerve enters brachial plexus.

a. The *first nerve* ascends in front of the neck of the first rib, and ends in the brachial plexus. It supplies a small intercostal branch to the first space, which furnishes muscular offsets, and becomes cutaneous by the side of the sternum, after the same course as the others. But there is not any lateral cutaneous branch from this nerve, except in those cases in which the next nerve is not as large as usual.

Has not, usually, cutaneous branch.

Second nerve.

b. The second nerve may extend a considerable way on the wall of the chest before entering between the intercostal muscles, and may ascend even to the first space. It is remarkable in having a very large lateral cutaneous branch (p. 217.).

Form of upper surface of diaphragm.

Upper surface of the diaphragm. — The diaphragmatic partition between the thorax and abdomen is specially described with the deep muscles of the latter cavity. The upper surface of the muscle which is turned to the thorax is on the whole convex, but the arch is greater on the right than the left side. The centre of the muscle is tendinous, but the lateral parts are fleshy. In contact with the upper surface are the lungs, one on each side, and the pericardium

Parts in contact with it.

in the middle. In the muscle are the following apertures: — one for the œsophagus and the pneumo-gastric nerves, another for the vena cava, and a third for the aorta with the thoracic duct and the vena azygos. The phrenic vessels and nerves enter the upper surface external to the pericardium; and the splanchnic and sympathetic nerves are transmitted to the abdomen through the posterior part. Apertures in it.

Parts passing through the upper aperture of the thorax. — In the middle line are the trachea and the œsophagus, and the origin of the sterno-hyoid and sterno-thyroid muscles, with the remains of the thymus gland in front of those tubes, and the longus colli muscle behind them. Between the two tubes is the recurrent nerve of the left side. On each side the bag of the pleura and the apex of the lung project into the neck; and between the pleura and the trachea and œsophagus, are found the several vessels and nerves that pass from the thorax to the neck, or in the opposite direction. Thus, first, on both sides, is the innominate vein with the phrenic and pneumo-gastric nerves, but behind these the parts on the two sides are different. On the right side, next in order from before backwards, are the innominate artery and the cardiac nerves; but on the left side the left common carotid artery, the thoracic duct, and the left subclavian artery, with the cardiac nerves. Lastly, altogether behind, on both sides, are the cord of the sympathetic, the first intercostal nerve, and the superior intercostal artery. Position of parts in the upper aperture. In middle line On each side. Partly the same on both sides, and partly not.

The dissectors of the thorax now wait while the dissection of the back is made. Afterwards they should examine the ligaments of the ribs and of the spine in the following section. The dissection of the back is now made.

Section II.

LIGAMENTS OF THE TRUNK.

The ligaments connecting the vertebræ to one another, the ribs to the spinal column and the sternum, and the pieces of the sternum one to another, are described in this section. Enumeration of the ligaments.

A rib is united with vertebræ and sternum.

Articulation of the Ribs. — The rib is united to the vertebræ on the one side, and to the sternum on the other, by three sets of ligaments, viz. one between the head of the bone and the bodies of the vertebræ; a second from its neck and tubercle to the transverse processes of the vertebræ; and a third, for each true rib, between its cartilage and the sternum.

To expose ligaments to the vertebræ.

Dissection.—For the purpose of examining the ligaments between the posterior part of the rib and the vertebræ, take a piece of the spinal column with the ribs attached. After removing the intercostal muscles and the cellular membrane from the surface of the bones, the ligaments that are superficial will be seen passing forwards to the spinal column and upwards to the transverse process. The ligaments attaching the cartilage of the rib to the sternum will be found on the part of the anterior wall of the thorax that was removed in opening the thoracic cavity.

Ligaments of head of rib are

A. *Ligaments of the head of the rib.*—The head of the rib is received into a hollow on the side of the bodies of two contiguous vertebræ, with the exception of the first, eleventh, and twelfth ribs; and it is provided with two retaining ligaments — costo-vertebral and interarticular, and between synovial sacs.

costo-vertebral or stellate,

The *costo-vertebral ligament*, which is also named *stellate* from its form, is composed of radiating fibres, that fix the rib to two vertebræ. It consists of three sets of fibres: the upper set is the largest, and is attached to the body of the vertebra above the rib; the lower one descends to the inferior of the two vertebræ, with which the head articulates; and the central part is united with the fibro-cartilage between those vertebræ.

inter-articular

The *interarticular ligament* is a short thin band, which is attached on one part to the ridge separating the articular surfaces on the head of the rib, and becomes blended by the other end with the interosseous substance between the vertebræ. In the first, eleventh, and twelfth ribs it is absent. This band will not be seen till the stellate ligament is divided.

with two sacs.

Synovial sacs. — There are two sacs to each rib, one on each side of the interarticular ligament, except in the three

ribs before mentioned, which have but one articular surface for each rib.

B. *Ligaments of the neck and tubercle of the rib.*—Three ligaments (costo-transverse) pass from the neck and tubercle of the rib to the transverse processes. There is one synovial sac between the rib and its transverse process. Ligaments of neck of rib,

The *anterior costo-transverse* ligament is larger and longer than the others, and ascends from the upper border of the neck of the rib to the lower edge of the transverse process of the upper of the two vertebræ, with which the head of the rib is connected. It is absent in the first and last ribs. Between this ligament and the vertebræ the posterior branches of the intercostal artery and dorsal nerve pass backwards. anterior costo-transverse.

The *posterior costo-transverse* is a short band of fibres between the tip of the transverse process of the lower of the two vertebræ, with which the head articulates, and the rough part of the tubercle of the rib. It is placed at the posterior aspect of the rib. If the fibres are divided, a *synovial membrane* will be seen to cover the surface of the bones which are in contact; but this is absent in the two lowest ribs. Posterior costo-transverse covers a synovial sac.

The *middle* or *interosseous costo-transverse* is placed horizontally between the neck of the rib and the transverse process with which the tubercle articulates. It will be best seen by sawing horizontally through the rib and the transverse process. Its fibres are near the lower margin of the transverse process, and are mixed with reddish cellular membrane. Middle costo-transverse.

C. *Ligaments of the cartilages of the ribs.*—The costal cartilages of the true ribs are united to the sternum by an anterior and a posterior ligament, which cover a synovial membrane; and they are further joined externally to the bony part of the rib. Some of the lower cartilages touch and are connected together by fibrous bands and synovial membrane. Union of the costal cartilages

a. In the *chondro-sternal articulation* the cartilages of the true ribs are received into the depressions on the side of the sternum, and are fixed in position by surrounding fibres, but chiefly in front and behind, where they give rise to an *an-* with the sternum;

terior and a *posterior ligament.* Between the cartilage and the articular surface of the bone is a *synovial* membrane. A separate band of fibres passes between the cartilage of the seventh rib and the xiphoid cartilage, and is named *costo-xiphoid ligament.*

with the rib; *b. Costal cartilage with the rib.*—The bony part of the rib is hollowed to receive the costal cartilage, and the two are united only by the investing membrane of the rib.

with one another. *c. One costal cartilage to another.*—The contiguous surfaces of the costal cartilages, from the sixth to the ninth, are connected by ligamentous fibres, and the surfaces in contact are lined by a synovial membrane.

Union of pieces of sternum. ARTICULATION OF THE PIECES OF THE STERNUM.—The upper piece of the sternum is connected to the lower by anterior and posterior longitudinal fibres, and between them is an intervening fibro-cartilage.

Two sets of ligaments unite the vertebræ. ARTICULATION OF THE VERTEBRÆ.—The several vertebræ composing the spinal column are united together by two sets of ligaments—one between the bodies, and the other between the processes of the bones.

These ligaments have a general resemblance along the spinal column, and one description will suffice, except for those between the first two vertebræ and the head, and those between the bones of the pelvis. The description of the special ligaments, thus excepted, will be found in the dissection of the neck (p. 158.) and of the ligaments of the pelvis.

How to see the several ligaments. *Dissection.*—After the dissection of the ligaments of the ribs, the same piece of the spinal column will serve for the ligaments of the bodies of the vertebræ and of their articular processes. It is supposed that the spinal canal has been opened to examine the spinal cord, and that the posterior ligament of the bodies of the vertebræ is therefore evident. If the canal should not be opened, the arches of the vertebræ must be sawn through close to the articular processes. The remaining ligaments between the arches and spines of the bones will be seen on those pieces that are taken away in opening the spinal canal.

The bodies are A. *Ligaments of the bodies of the vertebræ.*—The bodies of the vertebræ are united by an anterior and a posterior

common ligament, and by intervening pieces of fibro-cartilage. united by

The *anterior common ligament* is whiter and more fibrous than the posterior, and reaches from the atlas to the sacrum. The ligament is widest opposite the lumbar vertebræ, and becomes narrower as it is traced upwards. Its outline is also uneven, for it is rather wider opposite the bodies of the vertebræ than on the intervertebral substance. Its fibres are longitudinal in direction, and consist of a superficial and a deep layer. By detaching the ligament, the superficial fibres will be seen to reach the length of three or more vertebræ, whilst the deep pass from bone to bone. At its attachment a greater number of the fibres are found to be connected with the intervertebral fibro-cartilages than with the bones; and of those which are connected with a vertebra more are fixed to the margins than to the centre of its body. If the ligament is cut across at intervals it will be found to be thickest opposite the hollow part of the body of the vertebra. anterior common ligament, which varies in width, length, and attachment of its fibres, and in thickness.

The *posterior common ligament* is contained in the spinal canal, lying on the posterior aspect of the bodies of the vertebræ, and extends from the sacrum to the second vertebra. It is wider opposite the intervertebral substance than opposite the body of the vertebra, and its margins are therefore zigzag or dentate, especially in the lumbar part of the spine. Its fibres are superficial and deep, as in the anterior ligament, and are more closely united with the intervertebral substance than with the bone. The thickness and width of the ligament are greatest opposite the dorsal vertebræ. One surface of the ligament is in contact with the dura mater; and between the opposite surface and the vertebræ are the large veins issuing from the bones. Posterior common ligament is wide at parts: attachment and thickness. Connections.

Dissection. — To see the intervertebral substance, the anterior and posterior common ligaments should be taken away. One vertebra should be detached from the intervening fibro-cartilage to obtain a horizontal view of the same; and two other vertebræ should be sawn vertically to see the difference in its consistence. To see the intervertebral substance.

The *intervertebral substance* is placed between the con- Intervertebral

Substance has the shape of the bones, and gives the curves to the spine.

tiguous surfaces of the bodies of the vertebræ from the axis to the sacrum. Taking the shape of the vertebræ it forms a layer, or plate, of fibro-cartilage between those bones, and is connected, as before remarked, with the anterior and posterior common ligaments, and with the stellate ligaments of the heads of the ribs. These plates are thicker between the lumbar and cervical vertebræ, than between the dorsal vertebræ; and where the spinal column is arched forwards, as in the loins and neck, the convexity is due to the fibro-cartilages, which are there deepest at their anterior edge.

Formed of plates that surround a pulpy central part. Its layers are bent differently, and their fibres cross.

The disc of the intervertebral substance is united firmly to the surfaces of the bones. It is composed of a number of fibro-cartilaginous plates surrounding a central pulpy elastic matter, that projects when two bones and their intervening layer are sawn through. The plates of fibro-cartilage are arranged in layers, one within the other, like the scales of an onion, and their edges are connected to the bony surface; but they do not pass vertically from vertebra to vertebra, for the external plates are bent outwards, whilst those nearer the centre are bent so as to have the convexity of their curve turned towards the central pulpy part. Each layer of the fibro-cartilage is composed of oblique fibres, and the fibres of one layer are directed across those of another like the parts of the letter X. This disposition of the fibres will be best seen on the discs between the lumbar vertebræ by dissecting layer after layer.

Several ligaments of the vertebral processes.

B. *Ligaments of the processes of the vertebræ.*—The several processes of the vertebræ have special ligaments: thus the articular processes are united by a capsular ligament and a synovial membrane; the plates of the vertebræ are joined by yellow ligaments; the spinous processes have one band along the tip and another between them; and the transverse processes have bands of fibres between them in some parts.

Those of the articular processes are capsular and synovial sac.

a. Ligaments of the articular processes.—Between the articulating processes there is a moveable joint. The bones are covered with cartilage, and are surrounded by a loose *capsular* ligament of scattered fibres, which encloses a *synovial* membrane. In the cervical region of the spine, the

capsular ligaments are larger and looser than in the dorsal or lumbar part.

b. Ligaments of the arches. — The *ligamenta subflava*, so named from their colour, are situate between the plates or arches of the vertebræ, and close the spinal canal behind. These are two somewhat square ligaments in the interval between the arches of two contiguous vertebræ, one for each half of the arch, which approach one another along the middle line. Each consists of elastic yellow tissue, and is attached above to the inner surface of the half arch, but below to the upper border, and somewhat to the outer surface of the corresponding part of the arch next below. On each side the ligament reaches from the articular process to the root of the spinous process. Between the first two vertebræ and the skull there are special fibrous ligaments in the same situation (see p. 158.).

Those of the arches are two to each space.

Attachments.

c. Ligaments of the spines.—Along the tips of the spinous processes of the dorsal and lumbar vertebræ is a longitudinal band of fibres, *supraspinous* ligament. It is thicker in the lumbar than in the dorsal region of the spine, and is formed by superficial and deep fibres; the former reaching over three or more spines, whilst the latter pass from bone to bone. It is closely united with the tendons of the muscles.

Those of the spines are along their tip

In the dorsal and lumbar parts of the spinal column there are also found thin and somewhat membranous *interspinous* ligaments, which reach from the root to the tip of the spinous process. The strength of these bands is dependant upon the interval they have to fill; therefore they are more marked in the lumbar than in the dorsal vertebræ.

and between the spines.

d. Ligaments of the transverse processes. — Between the transverse processes of the lower dorsal vertebræ there are round bundles of fibres, *intertransverse ligaments*. In the lumbar vertebræ, also, there are thin membranous bands that close the intervals between the same processes.

Those of the transverse processes.

CHAPTER V.

DISSECTION OF THE BACK.

How the part is dissected.

This part of the body is either allotted to one student, or its dissection is undertaken conjointly by the dissectors of the head and upper limb; one preparing the parts in the neck, the other those in the dorsal and lumbar regions of the back. If the last arrangement is adopted, the dissector of the upper limb may direct his attention only to those paragraphs that are marked with an asterisk, and the dissector of the neck may take for the most part the paragraphs which are not so marked.

Position of body.

Position. — For this dissection the body lies with the face downwards, supported in that position by blocks beneath the chest and the pelvis, with the limbs hanging over the end and sides of the dissecting table. To make tense the neck depress the head, and fasten it with hooks.

Dissection to raise the skin.

Dissection. — In the back the student will meet with successive strata of large muscles, five in all, amongst which vessels and nerves are interspersed. The first step in the dissection is to raise the skin from the surface in two flaps, by means of the following incisions: — One cut is to be made along the middle line of the body, from the occipital protuberance to the back of the sacrum. Another incision is to be carried from the last dorsal vertebra to the acromion process of the scapula, and the flap of skin above it is to be turned outwards by both dissectors. The remaining piece of integument is to be detached by a transverse incision opposite the crest of the ilium, and then to be reflected by the dissector of the upper limb, in the same direction as the other flap. Under the upper flap of skin is the trapezius, and underneath the lower one is the latissimus dorsi muscle.

Seek cutaneous nerves.

The cutaneous nerves may now be sought in the subcutaneous cellular layer. These nerves vary much in size in the different parts of the back, and their number is also irregular. As a general rule, there is one corresponding to each vertebra. In the neck,

and opposite the upper part of the thorax, the nerves will be found to issue near the spines of the vertebræ; but over the lower part of the thorax, and in the loins, they are in a line with the angles of the ribs. Small cutaneous arteries accompany the nerves, and guide the dissector to their position. The cutaneous branches of the sacral nerves come into the dissection of the lower limb.

CUTANEOUS NERVES. — The tegumentary nerves of the back are derived from the posterior divisions of the spinal nerves, in one part coming from the external, and in another spot from the internal branches into which these bifurcate. Small arteries accompany the greater number of the nerves, and there is the same difference in them as in the nerves, respecting the branches from which they arise. Cutaneous nerves how derived.

The *branches* of the *cervical nerves* perforate the trapezius, and for the most part turn outwards in the integuments. There is one from each nerve, except from the first, and from the three last. The *branch* of the *second nerve* is named large occipital, and accompanies the occipital artery to the back of the head (p. 7.). The *branch* of the *third cervical nerve*, besides its transverse branch to the neck, gives upwards an offset to the lower part of the head, which is united with the great occipital nerve, and is distributed internal to it. In the neck.

* The *branches* of the *dorsal nerves* are directed outwards in the integument over the trapezius and latissimus dorsi muscles. Those of the *six upper* nerves perforate the trapezius near the spines of the vertebræ, and the branch of the second, which is larger than the rest, reaches as far as the scapula. The branches of the *six lower* nerves pierce the latissimus dorsi mostly in a line with the angles of the ribs; these are oftentimes uncertain in number. In the dorsal region.

* The *branches* of the *lumbar nerves* are derived only from the first three; they perforate the latissimus dorsi muscle in a line with the outer border of the erector spinæ, and crossing the crest of the ilium, are distributed in the integuments of the buttock. In the loins.

Dissection. — The cellular membrane is now to be taken from the trapezius and latissimus dorsi in the direction of the fibres of each, and the upper limb is to be carried backwards or forwards according as it may be necessary to put on the stretch the different fibres of the muscles. Some of the cutaneous nerves should be left, in order that they may be traced afterwards through the muscles to their origin. Dissection.

Two muscles in first layer. *First layer of muscles of the back.*—Two muscles, the trapezius and the latissimus dorsi, are found in this layer.

Trapezius. * The TRAPEZIUS MUSCLE is triangular in shape, with the base towards the spine, but the two muscles taken together have the form of a trapezoid figure. The muscle has an

Origin aponeurotic. extensive aponeurotic *origin* from the spines of the dorsal vertebræ and their supraspinous ligament, from the spinous process of the seventh cervical vertebra, from the ligamentum nuchæ between the last point and the head, and lastly from the superior transverse ridge of the occipital bone — the inner third. From this origin the fibres are

Insertion fleshy. directed outwards, converging to the shoulder, and are *inserted* into the outer third of the clavicle, at its posterior aspect; into the acromion; and into the upper edge of the

Connections. spine of the scapula. This muscle is subcutaneous. Along the middle line the tendinous origins of the trapezius of opposite sides form an aponeurosis of an oval form, which extends from the spine of the sixth cervical to that of the third dorsal vertebra; and on the outer side the lowest fleshy fibres end in a small triangular tendon that glides over the smooth surface at the root of the spine of the scapula. The anterior border bounds behind the posterior triangular space of the side of the neck. By its insertion the trapezius corresponds to the origin of the deltoid muscle.

Trace spinal accessory. *Dissection.* — The fibres of the trapezius are to be divided near the scapula, and over the spinal accessory nerve, so as to trace the ramifications of that nerve in the muscle, and its junction with the branches of the cervical plexus. A small artery to the trapezius (art. superficialis colli) accompanies the nerve.

Spinal accessory nerve in trapezius. The *spinal accessory nerve*, having crossed the posterior triangle of the neck, enters beneath the trapezius, and forms a kind of plexus with branches of the third and fourth nerves of the cervical plexus. The nerve is distributed to the muscle, and its filaments reach nearly to the lower border.

Dissection to reflect trapezius. *Dissection.* — To see the parts that are covered by the trapezius, divide the muscle longitudinally, internal to the position of the spinal accessory nerve, and throw inwards and outwards the two

parts. The dissector of the upper limb should clean the fibres of the rhomboidei and levator anguli scapulæ muscles, which are fixed to the base of the scapula, that bone being drawn away from the trunk to make tense the fibres. Whilst the dissector of the neck should expose the parts beneath the clavicle, viz. the posterior belly of the omo-hyoid muscle with the suprascapular nerve and artery, the transverse cervical vessels, and the small branches of nerves to the levator anguli scapulæ and rhomboid muscles. If the trapezius is detached in the neck, the ligamentum nuchæ, from which it takes origin, will be brought into view.

Parts covered by trapezius.

* The trapezius conceals in the neck the splenius and a small part of the complexus, with the levator anguli scapulæ; and in the dorsal region it covers the following muscles — the rhomboidei, the erector spinæ, and the latissimus dorsi. As it reaches the scapula it lies over the supraspinatus muscle.

Ligamentum nuchæ.

The *ligamentum nuchæ* is a narrow fibrous band that extends from the spinous process of the seventh cervical vertebra to the occipital protuberance. This structure serves as a partition between the muscles of opposite sides of the neck; and from the under part processes are sent down to be attached to the spinous processes of the six lower cervical vertebræ.

Latissimus dorsi is named from its shape. Origin is tendinous along middle line, and fleshy from some ribs.

* The LATISSIMUS DORSI is a thin and wide muscle in the back, but is pointed and fleshy towards the humerus. At its inner attachment the muscle is aponeurotic, and is connected with the posterior half of the crest of the ilium, with the spines of the sacrum, and with the spinous processes of the vertebræ as high as the fifth dorsal; further, the muscle has three or four fleshy processes of origin from as many of the lower ribs, which digitate with pieces of the external oblique muscle. All the fibres converge to the inferior angle of the scapula, and after crossing that point of bone are continued forwards to be *inserted* by means of a tendon into the bottom of the bicipital groove of the humerus. A small part of the upper border is covered by the trapezius; but near the scapula there is a space between the two muscles, in which the ribs and the intercostal and rhomboid muscles are seen. The lower or anterior border is either

Insertion into humerus. Connections.

parallel to the edge of the external oblique muscle of the abdomen in the interval between the last rib and the crest of the ilium, or it overlays that muscle. Frequently the latissimus has a distinct fleshy slip from the inferior angle of the scapula.

Dissection to reflect latissimus.

Dissection.— Divide the latissimus about midway between the spines of the vertebræ and the angle of the scapula, and reflect inwards and outwards its halves. In raising the inner part of the muscle, care must be taken not to destroy the thin serratus muscle and the aponeurosis which is continued upwards from it. In the interval between the last rib and the crest of the ilium the latissimus is adherent to the aponeurosis of the transversalis abdominis muscle, and should not be detached therefrom.

Parts covered by the latissimus.

* The latissimus dorsi muscle lies on the erector spinæ, the serratus posticus inferior, and the lower ribs with their intercostal muscles. As it rests on the angle of the scapula, it conceals the teres major and a part of the rhomboid muscle. Its relation to the teres is remarkable: at the angle of the scapula it is in contact with the posterior aspect of the teres, but nearer the humerus it turns round this muscle, and is inserted in front of it. Between the angle of the scapula and the humerus the latissimus forms part of the posterior boundary of the axilla.

Dissection of fascia lumborum.

Dissection. — After the latissimus dorsi is reflected, the dissector of the abdomen should examine the disposition of the posterior tendon of the transversalis abdominis between the last rib and the innominate bone. In this spot are the parts of the abdominal muscles that have been left in the previous dissection. Firstly, there may or may not remain a piece of the external oblique muscle. After the removal of this muscle (supposing a part to be left), the internal oblique is seen to be attached to a subjacent aponeurosis, and to the ribs and the crest of the ilium; its attachments above and below are to be cut through, and it is to be raised from the transversalis muscle, as far as it can be, towards the spine. Now the aponeurosis of the transversalis muscle (fascia lumborum) appears, and perforating it are two nerves: one the last dorsal, with an artery near the last rib; and the other the ilio-hypogastric, close to the crest of the ilium. Two offsets are prolonged from this fascia to the transverse processes. To see one prolongation cut through the latissimus dorsi, both its aponeu-

rosis and fleshy part, by an incision directed outwards from the middle line, on a level with the spinous process of the third lumbar vertebra, and gently raise the outer border of the muscle (erector spinæ), which is exposed thereby. By dividing this prolongation transversely, another muscle (quadratus lumborum) will appear: on raising the outer border of this last muscle the second offset of the fascia comes into view.

The *fascia lumborum* is the posterior aponeurosis of the transversalis abdominis muscle, and occupies the interval between the last rib and the crest of the ilium. By its cutaneous surface it gives attachment to the internal oblique muscle, sometimes to the external oblique, and slightly to the aponeurosis of the latissimus dorsi. The last dorsal and ilio-hypogastric nerves pierce the aponeurosis in their course from the abdomen. From the inner or posterior part of the aponeurosis two prolongations reach to the transverse processes of the lumbar vertebræ. The more superficial of the two is the strongest; and passing beneath the erector spinæ (in this position of the body), it is connected to the apices of the transverse processes, filling the intervals between those pieces of bone. The deeper or anterior prolongation passes on the abdominal surface of the quadratus lumborum, and is fixed to the roots of the transverse processes and to the bodies of the vertebræ. Thus the prolongations of the fascia contain the quadratus lumborum in a sheath; and the erector spinæ lies in another sheath, which is formed by the aponeurosis of the latissimus on the one side, and the posterior prolongation of the fascia lumborum on the other.

Fascia lumborum is part of transversalis abdominis;

has two offsets behind;

one to apex,

the other to root of transverse processes, which form sheaths for muscles.

The *second layer of muscles* consists of the elevator of the angle of the scapula, and of the large and small rhomboid muscles. Besides these, there will be found in the neck the posterior belly of the omo-hyoid muscle, with some vessels and nerves that turn backwards towards the scapula.

Second muscular layer.

The LEVATOR ANGULI SCAPULÆ arises by tendinous slips from the posterior tubercles of the transverse processes of the three or four upper cervical vertebræ. The fibres form rather a roundish muscle, and are *inserted* into the base of

Elevator of angle of scapula.

Attachments and connections. the scapula between the spine and the superior angle. At its origin the muscle is beneath the sterno-mastoideus, and at its insertion beneath the trapezius, the rest of the muscle appears in the posterior triangular space of the neck. Beneath it are some of the other muscles of the neck (splenius and cervicalis ascendens).

Rhomboid muscles are two. * RHOMBOIDEI MUSCLES. — The thin muscular layer that is attached to the base of the scapula consists of two pieces, larger and smaller, which are separated by a cellular interval.

Small muscle. * The *rhomboideus minor* is a small narrow band that *arises* from the spinous process of the seventh cervical vertebra, and from the ligamentum nuchæ, and is *inserted* into the base of the scapula opposite the smooth surface at the root of the spine of that bone. Attachments.

Large muscle. Origin. * The *rhomboideus major* is larger than the preceding by the width of three spinous processes. It *arises* from the spinous processes of the four or five upper dorsal vertebræ, and from the supraspinous ligaments; and its fibres are directed outwards to be fixed to the base of the scapula between the spine and the lower angle. Sometimes all the fibres do not reach the scapula, but some end on a tendinous arch near the bone. These muscles are covered in part by the trapezius and the latissimus, but a portion of the larger rhomboid muscle is subcutaneous near the angle of the scapula. Insertion. Connections.

Posterior belly of omohyoideus. Origin The OMO-HYOID MUSCLE consists of two fleshy bellies, anterior and posterior, which are united by an intervening tendon. Only the posterior part is now seen. The muscle *arises* from the superior border of the scapula behind the notch, and from the ligament that converts the notch into a foramen. The fibres form a thin riband-like muscle, which is directed forwards across the lower part of the neck, and ends anteriorly in a tendon beneath the sterno-mastoideus. This muscle is placed partly beneath the trapezius, and is partly superficial in the posterior triangular space of the neck, where it lies above the clavicle and the subclavian and termination. Connections.

artery. It lies on the brachial plexus, and near the scapula, on the suprascapular vessels and nerve.

The *suprascapular artery* is a branch of the subclavian artery, and is directed almost horizontally outwards across the lower part of the neck to the back of the scapula. The artery lies at first behind the clavicle, and appears in the small space that contains the third part of the subclavian artery: farther out it enters beneath the trapezius, and is directed beneath the omo-hyoid muscle, with the suprascapular nerve, to the supraspinal fossa of the scapula. Before entering the fossa it furnishes a small branch (supra-acromial) to the upper surface of the acromion. Suprascapular artery of the subclavian ends on back of scapula.

The *suprascapular nerve* is an offset of the brachial plexus, and is inclined backwards to the superior costa of the scapula. It passes beneath the supraspinatus muscle, through the notch in the superior costa of the bone, and its termination in the muscles on the dorsum of the scapula is seen in the dissection of the arm (p. 240.). Suprascapular nerve accompanies artery.

The *transverse cervical artery* is also a branch of the subclavian, and has the same direction as the suprascapular branch, viz. towards the posterior part of the neck, but it is placed at a greater height above the clavicle. Crossing the upper part of the space in which the subclavian artery lies, this branch passes beneath the trapezius, and divides into the two following branches—superficial cervical and posterior scapular:— Transverse cervical artery of the subclavian divides into

a. The *superficial cervical branch* is distributed chiefly to the under surface of the trapezius, though it furnishes offsets to the levator anguli scapulæ and the cervical glands. superficial cervical and

b. The *posterior scapular branch* crosses beneath the elevator of the angle of the scapula, and then turns downwards along the base of that bone beneath the rhomboid muscles. If these muscles are divided, the artery will be seen to furnish branches to them, and to give anastomotic twigs to both surfaces of the scapula, which join the other arteries distributed on the bone. posterior scapular

The *veins* have the same name and course as the arteries above described; they open into the external jugular vein near its junction with the subclavian vein. Accompanying veins.

Nerve to the rhomboid muscles.—This slender nerve of the brachial plexus (p. 69.) takes the same course as the preceding artery, beneath the elevator of the angle of the scapula. Before its termination it supplies one or two twigs to the elevator of the scapula, and it is lost in the rhomboidei on their under surface. Nerve of rhomboid muscle.

Dissection.—Reflect the rhomboidei muscles towards the spinous Dissection.

processes, and remove the cellular membrane from the thin serratus muscle which is beneath them.

Third layer of muscles. In the *third layer* are the following muscles: the serratus posticus superior and inferior, with the splenius.

Serrati are two in number. * The SERRATI muscles are very thin, and receive their name from their mode of attachment to the ribs. They are two in number, superior and inferior, and have aponeurotic origins from the spines of the vertebræ.

Smaller one at upper part of the thorax. * The *serratus posticus superior* is connected at its origin with the ligamentum nuchæ and with the spinous processes of the last cervical and two or three upper dorsal vertebræ. The fleshy fibres are inclined downwards, and are attached by slips to the second, third, and fourth ribs, external to their angles. This muscle rests on the splenius.

Larger muscle at lower part of thorax. * The *serratus posticus inferior* occupies the lumbar region, and is wider than the preceding muscle. Its aponeurosis of *origin* is inseparably united with that of the latissimus dorsi, and is connected to the spinous processes of the two

Connections. last dorsal and three first lumbar vertebræ. The fleshy fibres ascend to be inserted by offsets into the four last ribs in front of their angles, each successive process extending further forward than the one below. This muscle lies on the mass of the erector spinæ, and from its upper border proceeds the vertebral aponeurosis.

Vertebral aponeurosis. * The *vertebral aponeurosis* is a fibrous expansion, which is spread over the fourth layer of muscles, and confines them

Attachments. in the hollow by the side of the spinous processes. Attached inferiorly to the upper border of the inferior serratus, the aponeurosis is continued beneath the superior serratus, and binds down the splenius muscle. Internally, it is fixed to the spines of the vertebræ, and externally it is inserted into the angles of the ribs.

Dissection. *Dissection.*—Divide the superior serratus, and clear away the subjacent vertebral aponeurosis, and the splenius muscle will be exposed.

Splenius has two parts. The SPLENIUS muscle consists of cervical and cranial parts, which are named respectively splenius colli and splenius capitis. The two are frequently united in their origin.

The *splenius colli* arises from the spines of the three or four upper dorsal vertebræ, beginning at the sixth. Ascending in the neck, the muscle is *inserted* by tendinous processes into the posterior tubercles on the transverse processes of the three upper cervical vertebræ, and behind the attachment of the elevator of the angle of the scapula. One to the neck.

The *splenius capitis* arises from the spines of the last cervical and two first dorsal vertebræ, and from the ligamentum nuchæ as high as the third cervical vertebra. The fleshy fibres ascend and are inserted into the apex and posterior part of the mastoid process, and into the ridge behind it for about an inch. One to the head.

The splenius colli is smaller than the splenius capitis, and its fibres are more oblique. These muscles are beneath the trapezius, the rhomboidei, and the serratus superior; and the insertion into the occipital bone is beneath the sterno-mastoid muscle. The complexus muscle will be seen appearing above the upper border of the splenius capitis. Their connections with other muscles.

Dissection. — To expose the fourth layer of muscles, detach the splenii from the spinous processes, and throw them outwards. Detach also the serratus inferior in the same way with the vertebral aponeurosis, and clear the cellular membrane from the surface of the large mass of the erector spinæ that now comes into view. Dissection of fourth layer.

Opposite the last rib is the beginning of a cellular interval which divides the mass into an outer piece (sacro-lumbalis), and an inner piece (longissimus dorsi). By sinking the knife into this interval, the sacro-lumbalis may be turned outwards, so as to expose the fleshy slips of its accessory muscle, which are fixed to the angles of the ribs. A thin narrow muscle (cervicalis ascendens), which is continued from the sacro-lumbalis beyond the ribs, should be separated in the neck from the muscles around by the dissector of this part. Sacro-lumbalis and accessory muscles. Offset to the neck.

In dissecting the sacro-lumbalis muscle, the external branches of the dorsal nerves with their accompanying arteries will be exposed. Vessels and nerves.

Before the longissimus is displayed, raise towards the spinous processes a thin muscular fasciculus of the spinalis dorsi, which lies between it and the spines of the vertebræ in the dorsal region. Now seek the attachments of the longissimus dorsi. Externally the muscle has thin muscular processes of insertion into about the lower eight ribs. Internally it is inserted into the transverse pro- Longissimus dorsi and prolongations.

cesses of the lumbar and dorsal vertebræ by rounded tendons; and for the purpose of seeing these tendons, the longissimus must be drawn away from the transverse processes, and its superficial aponeurosis must be cut through below the ribs, in the line of separation between this muscle and the multifidus spinæ on its inner side. Between the longissimus and multifidus spinæ are the internal branches of the dorsal nerves, and of the intercostal and lumbar arteries. The dissector of the neck should trace upwards a fleshy prolongation of the longissimus beyond the ribs: this is blended at first with the fibres of the longissimus; but it is afterwards divided into a cranial part (trachelo-mastoid) and a cervical part (transversalis colli).

Vessels and nerves.

Offsets to the neck.

Fourth layer.—In this layer are included the spinalis dorsi; the erector spinæ, with its divisions and its accessory muscles to the neck; and the complexus muscle. Most of the vessels and nerves of the back are in connection with this layer of muscles.

Fourth layer of muscles consists of

* The SPINALIS DORSI is found only by the sides of the spines of the dorsal vertebræ. Inferiorly it *arises* by tendinous processes from the spines of the last two dorsal and the first two lumbar vertebræ. From this origin the fibres ascend, forming arches whose concavity looks inwards, and are connected by tendinous processes to the spines of the dorsal vertebræ, as low as the eighth, or only for half that extent.

Spinalis dorsi, only along the dorsal vertebræ.

* The ERECTOR SPINÆ is the muscular mass that lies on the side of the spine in the lumbar region. It is single and pointed below, and its cutaneous surface is covered near the sacrum by a dense aponeurosis, which is common to it and the multifidus spinæ. The muscle *arises* from the aponeurosis above mentioned, and from the inner surface of the innominate bone at its posterior part; and it divides opposite the last rib into sacro-lumbalis and longissimus dorsi. The attachment on the inner aspect of the os ilii corresponds to the origin of the gluteus maximus on the outer aspect.

Erector spinæ is single at its origin, but is divided at the last rib into two.

* The SACRO-LUMBALIS (ilio-costalis) is the smallest part resulting from the division of the erector spinæ. The fibres that compose it end in six or seven flat tendons, which are connected together by their margins, and are inserted into

Sacro-lumbalis is inserted

the angles of as many of the lower ribs. The muscle is continued onwards to the other ribs, and to the neck by the two under-mentioned parts:— into six lower ribs.

* The *musculus accessorius ad sacro-lumbalem* begins by a series of bundles on the angles of the six lower ribs, internal to the tendons of insertion of the sacro-lumbalis; and ends in tendons which are *inserted* into the remaining ribs (upper six) in a line with those of the sacro-lumbalis, and into the transverse process of the seventh cervical vertebra. Musculus accessorius is attached to the ribs.

* The *cervicalis ascendens* is a muscular slip that continues the accessorius into the neck. More or less united with the preceding, this muscle arises from four ribs (third, fourth, fifth, and sixth), and is inserted into the transverse processes (posterior tubercles) of the cervical vertebræ with the same numerical designation. Cervicalis ascendens reaches the neck.

* The LONGISSIMUS DORSI gradually decreases in size as it ascends along the thorax. Internally the muscle is *inserted* into the transverse processes of all the lumbar and dorsal vertebræ by a series of bundles; and externally into the ribs, except the two or three first, by thin fleshy processes which are fixed between the tubercle and angle. In the lumbar region the innermost insertion is in part fleshy, and is connected with the whole length of the transverse process; and in part tendinous, where it is fixed to the pit at the root of the process: some fibres likewise reach beyond that process, and are attached to the layer of the fascia lumborum. The muscular prolongation to the neck is inseparably united with the upper fleshy fibres of the longissimus, and splits into the two following pieces:— Longissimus dorsi is inserted into ribs and transverse processes; is continued to the neck by the

The *transversalis colli* arises from the transverse processes of about four dorsal vertebræ (sixth, fifth, fourth, and third), and is *inserted* into the transverse processes (posterior tubercles) of the cervical vertebræ, except the first and last. transversalis colli,

The *trachelo-mastoid* muscle arises in common with the preceding, and has besides an attachment by distinct tendons to the transverse processes of the four last cervical vertebræ. and to the head by the trachelo-mastoid.

The fibres form a thin muscle that is *inserted* into the posterior part of the mastoid process beneath the splenius.

Connections of the erector spinæ. The erector spinæ and its prolongations occupy the lumbar, thoracic, and cervical parts of the back. In the loins the muscle is contained in an aponeurotic sheath (p. 363.), and has the multifidus spinæ on its inner side. Opposite the ribs the sacro-lumbalis and longissimus dorsi are concealed by the muscles of the other layers which have been examined. In the neck the accessory small muscles are beneath the splenius and trapezius; the cervicalis ascendens is attached in a line with the splenius colli; and the transversalis colli and trachelo-mastoid are more internal, or between these and the complexus.

Complexus. The COMPLEXUS is internal to the prolongations from the longissimus dorsi, and converges towards its fellow of the opposite side at the occipital bone. Narrow at its lower end, Origin. the muscle *arises* by tendinous points from the transverse processes of the three upper dorsal vertebræ, and from the articular processes of the cervical vertebræ as high as the third. From the tendons of origin the fibres pass upwards, Insertion. the inferior more vertically than the superior, to be *inserted* into an impression between the curved lines of the occipital bone. Closely united to the inner border is the following muscular slip:—

Its accessory piece. The *biventer cervicis* is so named from its having two fleshy bellies with an intervening tendon. It *arises* from two or three transverse processes of the dorsal vertebræ, below the Attachments. attachment of the complexus, and is *inserted* into the occipital bone internal to that muscle. The biventer cervicis frequently receives a fleshy slip from the spines of one or two of the lower cervical vertebræ.

Connections. The complexus and biventer cervicis muscles are concealed by the splenius and trapezius; and the cutaneous surface of the complexus presents a tendinous cross intersection. Two or three of the cervical nerves perforate the complexus. Along the inner side is the semispinalis muscle, with the ligamentum nuchæ. Beneath the muscle are the small recti and obliqui muscles, the semispinalis, and the cervical nerves.

Dissection.—To expose the nerves and vessels in the neck, it will be necessary to detach the complexus from the occipital bone and the spines of the vertebræ, and to raise it with care from the subjacent parts. Beneath the muscle is a dense fascia in which are contained the ramifications of the internal branches of the four or five highest cervical nerves. The first or suboccipital nerve is the most difficult of the set to find, though the whole should be sought with some care. This little nerve is a short trunk that is contained in the interval between the recti and obliqui muscles near the head, and it will be best found by looking for the small twigs that are furnished by it to the recti muscles. The branches of the three last cervical nerves are beneath the muscular fibres of the semispinalis. The external branches of the cervical nerves are very small, and are given off close to where the trunks appear. In the dissection of the nerves the deep cervical artery is exposed on the semispinalis muscle; also the vertebral artery is found with the suboccipital nerve; and the occipital artery will be seen crossing the occipital bone. Dissection of the nerves of the neck and the vessels

* Opposite the thorax the dorsal nerves and vessels will readily come into view by the removal of a little cellular membrane from between the transverse processes, and on the inner side of the longissimus dorsi muscle. External and internal branches are to be traced from each trunk; the former have been seen in the interval between the sacro-lumbalis and longissimus dorsi. of the same in the dorsal region.

* The lumbar nerves and vessels resemble the dorsal, and are found in the same line; but the inner branches are more difficult to recognise. In the lumbar region.

The sacral nerves are beneath the multifidus spinæ muscle, and will be exposed after its examination.

Posterior Division of the Spinal Nerves.—The spinal nerves, with a few exceptions in the cervical and sacral parts of the spinal column, bifurcate in the intervertebral foramina into anterior and posterior trunks. The posterior trunks turn backwards to supply the integument and the muscles of the back. Posterior division of spinal nerves.

Cervical nerves.—All the posterior divisions of the cervical nerves, except those of the first two, appear beneath the posterior intertransverse muscles, and divide into an inner and an outer branch of distribution; but, both in the first and second nerves, the posterior division crosses the arch of the vertebra next beneath, after leaving its ganglion. In the neck they divide into two.

External branches are small. *a.* The *external branches* are very inconsiderable in size, and end in the muscles inserted into the transverse processes, viz. the splenius, and the prolongations from the erector spinæ muscle. None to the first. The first or suboccipital nerve has not any external branch.

Internal branches above three last give cutaneous offsets. *b.* The *internal branches* are larger than the external; but the first nerve is likewise excepted from this statement. All are directed inwards towards the spinous processes; but the branches of the second, third, fourth, and fifth nerves are superficial to the semispinalis, whilst those of the three lowest nerves are beneath that muscle. By the side of the spines of the vertebræ, cutaneous branches are given from those nerves that are superficial to the semispinalis, and ascend to the surface through the splenius, the complexus, and the trapezius muscles, to be distributed as before seen (p. 359.). These nerves supply the surrounding muscles, viz. the complexus, semispinalis, multifidus spinæ, and inter-spinales. Branch of second. The branch of the second nerve is the largest of the series, and turns upwards over the inferior oblique muscle, after it appears beneath the lower border of that muscle; taking then the name, great occipital nerve, it pierces the complexus, and ends on the surface of the occiput.

Suboccipital nerve *Suboccipital nerve.* — The posterior division of this nerve is the smallest of the set, and is an exception to the others in its arrangement. Passing from the spinal canal, between the arch of the atlas and the vertebral artery, the nerve pierces the ligament between the occipital bone and the first vertebra, and appears in the supplies muscles. hollow between the recti and obliqui muscles. It is a short trunk, from which the following muscular branches radiate: — One enters the under surface of the complexus near its cranial attachment. A slender branch is also furnished to each of the small muscles that bound the space in which the nerve is contained, viz. to the rectus major and minor, and to the superior and inferior oblique. The branch to the last muscle often joins the Occasionally a cutaneous offset. inner branch of the second cervical nerve. Occasionally the suboccipital nerve gives a cutaneous branch to the occiput.*

Posterior cervical plexus. The suboccipital nerve and the internal branches of the two next cervical nerves are sometimes connected by branches beneath the complexus: and in such case they form the "posterior cervical plexus" of M. Cruveilhier.

Twelve dorsal nerves *Dorsal nerves.*— These nerves are twelve in number, and appear between the transverse processes. Each nerve

* See note to p. 139. of the first edition of this work.

soon divides into an internal and an external branch, which are distributed after the same plan as those in the neck. Cutaneous nerves are furnished from one or another set of the branches, but not from both branches of the same nerve.

divide into inner and outer branches.

The *external branches* increase in size from the first to the last, and are differently distributed above and below. The upper six pass beneath the longissimus and its cervical prolongation, as far as to the interval between the longissimus and the sacro-lumbalis, and end by supplying these muscles and the levatores costarum. The lower six have a similar arrangement and distribution with respect to the muscles; but after reaching the cellular interval between the sacro-lumbalis and the longissimus dorsi, they are continued to the surface through the serratus and latissimus muscles, in a line with the angles of the ribs.

Outer branches of upper six end in muscles, but those of lower six give cutaneous offsets.

* The *internal branches* decrease in size from above downwards. The upper six are directed inwards between the semispinalis dorsi and multifidus spinæ muscles, and become cutaneous along the side of the spinous processes, by perforating the rhomboideus, trapezius, and latissimus dorsi muscles. Offsets are supplied to the muscles between which they are placed. The lower six are small in size, and end in the multifidus spinæ muscle.

Inner branches. Upper six have cutaneous offsets. Lower six not.

* *Lumbar nerves.* — These are five in number, and appear between the erector and multifidus spinæ. In their general arrangement they resemble the dorsal nerves. Cutaneous offsets are furnished only by the external set of branches.

Lumbar nerves are divided into two.

* *a.* The *external branches* enter the fibres of the erector-spinæ, and supply it and the small intertransverse muscles. The three first pierce the erector spinæ, and become cutaneous nerves after piercing the aponeurosis of the latissimus. The outer branch of the last nerve is connected with the first sacral nerve by an offset which lies near the bones.

External branches give cutaneous from first three.

* *b.* The internal branches are supplied to the multifidus spinæ muscle. Near their origin they are difficult to find, in consequence of being contained in grooves near the articular processes of the vertebræ.

Internal branches end in the muscles.

Vessels in the Back. — The vessels that are now dissected are the occipital and the deep cervical artery, part of the vertebral artery, and the posterior branches of the intercostal and lumbar arteries of the aorta.

The vessels are

Part of the occipital artery,

The *occipital artery* is seen in the part of its course along the occipital bone. Appearing from beneath the digastric muscle, this vessel is directed backwards beneath the sterno-mastoideus, the splenius, and sometimes the trachelo-mastoideus, but over the obliquus superior and complexus muscles. Near the middle line it perforates the trapezius and ascends to the occiput, on which it is distributed (p. 5.). It supplies the surrounding muscles, and furnishes the following branch to the neck:—

which gives a

cervical branch.

The *cervical branch* (r. princeps cervicis) supplies twigs to the under part of the trapezius, and then passing beneath the complexus, anastomoses with the vertebral and deep cervical arteries.

Part of the vertebral artery.

The part of the *vertebral artery* now exposed lies on the posterior arch of the first vertebra, behind the articulating process of that bone, and appears in the interval between the straight and oblique muscles, before perforating the ligament between the atlas and occipital bone to enter the skull. Small branches are supplied by the vessel to the surrounding part. Beneath the artery is the suboccipital nerve.

Deep cervical artery.

The *deep cervical artery* is a branch of the superior intercostal (of the subclavian), and resembles the posterior branches of the other intercostal arteries. Passing backwards between the transverse process of the last cervical vertebra and the neck of the first rib, the vessel appears in this dissection between the complexus and semispinalis muscles. Finally, the artery ascends as high as the extent of the semispinalis muscle, and anastomoses with the cervical branch of the occipital artery. The contiguous muscles receive branches from the deep cervical artery, and anastomoses are formed between its branches and those of the vertebral artery.

Intercostal arteries are split into

* *Intercostal arteries.* — The posterior branches of these vessels accompany the nerves between the vertebræ and the anterior costo-transverse ligaments. In the back they are divided into inner and outer branches.

inner and

* The *inner branches* end in the fleshy mass of the multifidus spinæ and semispinalis muscles, and furnish small offsets with those nerves that reach the surface.

outer branches,

* The *external branches* cross beneath the longissimus dorsi, and supply it and the erector spinæ. Like the nerves, the lowest branches of this set are the largest, because they extend to the surface.

and give a branch to spinal cord.

* *Spinal branch.*—As the dorsal branch of the intercostal artery passes by the intervertebral foramen, it furnishes a small artery to the spinal cord and its membranes, and other branches to the vertebræ.

* *Lumbar arteries.* — The posterior branches of the lumbar arteries divide, like the intercostal, into internal and external branches, as soon as they reach the interval between the longissimus dorsi and multifidus spinæ. They give also a *spinal branch* to the spinal canal, and to the cord and the membranes investing it. Lumbar arteries are also divided into

* The *internal branches* are small, and end in the multifidus spinæ muscle. inner and

* The *external branches* supply the erector spinæ, and some are continued onwards, with the nerves, to the integuments. outer branches.

VEINS. — With the deep cervical artery is a large vein, *vena profunda cervicis*, that communicates with the occipital and other deep veins in this region, forming the posterior plexus of the neck, and then passes forward between the transverse processes with the artery, to join the vertebral vein. The *occipital vein* is with its artery, and sometimes joins the lateral sinus through the mastoid foramen. The *dorsal* and *lumbar* veins correspond to the arteries they accompany in their branching and distribution, and end in the intercostal veins. In contact with the spinous processes and plates of the vertebræ is a deeper set of veins (*dorsi spinal*), which anastomose freely together, and enter the veins in the interior of the spinal canal. Veins are deep cervical, occipital, dorsal, and lumbar, and deep veins.

Dissection. — Most of the remaining muscles of the back are exposed by the previous dissection. Thus, between the first two vertebræ and the occipital bone are the small straight, and oblique muscles. In the cervical and dorsal regions is seen the semispinalis muscle, with the small interspinales muscles internal to it; and occupying a corresponding position in the loins is the multifidus spinæ muscle. The small intertransverse muscles of the lumbar vertebræ will be found by cutting through the erector spinæ. Dissection of the last layer of muscles.

FIFTH LAYER. — In this layer are included the following small muscles, viz. the recti and obliqui, the semispinales, interspinales, multifidus spinæ, and intertransversales. Muscles of the fifth layer.

The RECTUS CAPITIS POSTICUS MAJOR occupies the middle line of the body, and is the larger of the two muscles between the occipital bone and the first vertebræ. It *arises* from the spine of the second vertebra, and is *inserted* by rather a widened part into the inferior curved line of the occipital bone, beneath the superior oblique muscle. This Rectus capitis major passes between axis and occipital bone.

muscle is very oblique in its direction, and forms one side of the triangular space that contains the suboccipital nerve.

Rectus capitis minor

The RECTUS CAPITIS POSTICUS MINOR is internal to the preceding, and is the smallest of the four muscles between the occipital bone and the first two vertebræ. *Arising* from the posterior arch of the atlas, the muscle ascends to be *inserted* into the occipital bone between the inferior curved line and the foramen magnum. This small muscle is fan shaped, and is deeper than the rectus major: it covers the ligament between the atlas and the occipital bone.

passes from atlas to occipital bone.

Obliquus inferior

The OBLIQUUS INFERIOR muscle *arises* from the spinous process of the second vertebra or axis, external to the rectus major muscle, and is *inserted* into the transverse process of the atlas or first vertebra. This muscle lies obliquely between the first two vertebræ.

is between first two vertebræ.

Obliquus superior

The OBLIQUUS SUPERIOR muscle takes *origin* from the extremity of the transverse process, where the preceding muscle terminates, and is directed inwards to be *inserted* above the inferior curved line of the occipital bone, near the mastoid process. This muscle is concealed by the complexus and trachelo-mastoideus, and crosses the vertebral artery. Its insertion is beneath the splenius, but above the rectus major muscle.

extends from atlas to occiput.

Connections.

Semispinalis

The SEMISPINALIS occupies the dorsal and cervical regions, and extends from the transverse to the spinous processes of the vertebræ. The lower part of the muscle is called semispinalis dorsi, and the upper part semispinalis colli.

is divided into

semispinalis colli, and

The *semispinalis dorsi* arises from the transverse processes of the dorsal vertebræ, from the tenth to the sixth; and is *inserted* into the spinous processes of the four upper dorsal and the two last cervical vertebræ.

semispinalis dorsi.

The *semispinalis colli* arises from the transverse processes of the five or six upper dorsal vertebræ, and from the articular processes of the cervical vertebræ except the three first: it is inserted into the spines of the cervical vertebræ above the attachment of the semispinalis dorsi, the atlas not receiving any slip.

Connections.

The semispinalis muscle is covered by the complexus,

and by the deep cervical artery and the cervical nerves. To its inner side is the multifidus spinæ muscle.

The INTERSPINAL MUSCLES are placed as their name expresses: they are best seen in the neck and loins, for they are only rudimentary between the spines of the dorsal vertebræ. Inter-spinal muscles

In the cervical region these muscles are arranged in pairs between the spinous processes, except between those of the first two vertebræ. They are small round bundles, and are attached above and below to the bifurcated apices of the spines of the vertebræ. In the lumbar region the interspinal muscles are thin flat bands. in the neck double; in loins single.

* The INTERTRANSVERSE MUSCLES are found between the transverse processes of the cervical and lumbar vertebræ. Only those in the loins are now exposed, where they form thin planes of muscular fibre, one in each intertransverse space. In the neck they are double, like the interspinal muscles of the same vertebræ. In the dorsal vertebræ there is a tendinous structure that occupies the place of the intertransverse muscle, but in the two last spaces there is muscular fibre. Inter-trans-verse muscles in loins, in neck, and dorsal region.

Dissection.—Expose now the multifidus spinæ muscle which fills the hollow by the side of the spinous processes. Over the sacrum it will be necessary to remove from it the thick aponeurosis that gives origin to it and the erector spinæ. This aponeurosis will be found connected in the middle line with the spines of the lumbar vertebræ and sacrum; and on the outer side it is attached to the posterior part of the crest of the ilium, and to the outer row of tubercles on the back of the sacrum, being here connected with the great sacro-sciatic ligament. In the neck and the dorsal region the semispinalis should be detached from the spines, and be turned aside from the multifidus spinæ. Dissec-tion of multi-fidus spinæ.

* The MULTIFIDUS SPINÆ muscle extends from the sacrum to the second vertebra, and is much larger towards the pelvis than in the neck. Its *origin* inferiorly is from the back of the sacrum, between the central and external row of processes, as low as the fourth aperture; from the inner part of the posterior superior spinous process of the innominate bone; as well as from the ligaments connecting this Multi-fidus spinæ has an exten-sive origin.

bone to the sacrum. Higher in the back, the muscle arises from the articular processes of the lumbar vertebræ, from the tranverse processes of the dorsal vertebræ, and from the articular processes of the cervical vertebræ. From this extensive origin the fibres are directed obliquely inwards, some extending more than the length of one vertebra, to be *inserted* into the spines and the laminæ of all the vertebræ except the first. This muscle chiefly fills the vertebral groove, and is concealed by the erector spinæ and the semi-spinalis. The internal branches of the vessels and nerves of the back lie along its outer border. The following small muscles may be said to be parts of the multifidus.

Inser-tion.

Connec-tions.

* *Rotatores spinæ.* — These are small muscles beneath the multifidus spinæ in the dorsal region, and are separated from that muscle by cellular tissue. Each is attached on the one hand to the transverse process, and on the other to the lower part of the lamina of the vertebra.

Rotatores spinæ are parts of multifidus.

Dissection. — To expose the branches of the sacral nerves it will be necessary to remove the part of the multifidus spinæ that covers the sacrum. These nerves may be detected by following inwards their external branches on the surface of the great sacro-sciatic ligament. The two lowest nerves will be found on the back of the sacrum, appearing through the apertures below the extent of the multifidus spinæ muscle.

Dissection of sacral nerves.

Sacral Nerves. — The posterior divisions of the sacral nerves are five in number, and issue from the spinal canal by the apertures in the back of the sacrum. The three first have the common division into inner and outer branches, like the other spinal nerves, but the last two are undivided.*

Five sacral nerves: are differently distributed.

* *First three nerves.* — The *inner branches* of these nerves end in the multifidus spinæ muscle. The *outer branches* are larger in size, and are united together on the back of the sacrum; but the outer branch of the first nerve is further connected with the corresponding part of the last lumbar, and that of the third nerve joins in a similar manner the sacral nerve next below. After this looping, the nerves pass outwards to the surface of the great

Three first have inner and outer branches; the last give cutaneous offsets.

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* See a paper on the branching of the posterior divisions of the spinal nerves, by the Author, in the Lond. Med. Gazette of Feb. 10. 1843.

sacro-sciatic ligament, where they again join, and then become cutaneous.—(See DISSECTION OF THE BUTTOCK.)

* *Two last nerves.* — These nerves are much smaller than the preceding, and are undivided: they are connected one with another, and with the coccygeal nerve on the back of the sacrum. A few filaments are distributed to the back of the sacrum and the coccyx. Two last are undivided.

* The *coccygeal nerve* may be recognised by the side of the coccyx with care. It is joined by the last sacral nerve, and ends on the posterior aspect of the coccyx. Coccygeal nerve.

* Small *arteries* leave the spinal canal with the sacral nerves; they supply the muscular mass of the erector spinæ and the structures on the back of the sacrum. Anastomoses take place between these vessels and the branches on the sacrum from the gluteal and sciatic arteries. Small sacral arteries.

Dissection. — The examination of the posterior part of the wall of the thorax should be made before the body is again turned. By the removal of the sacro-lumbalis and longissimus dorsi opposite the ribs, the small levatores costarum will be seen. The external intercostal muscle will be exposed at the same time. Dissection of intercostal structures.

* The LEVATORES COSTARUM are small fan-shaped muscles that *arise* from the apex of the transverse processes of the dorsal vertebræ, and are *inserted*, the fibres spreading out, into the upper border of the rib beneath. These muscles are twelve in number, and the first is fixed to the transverse process of the last cervical vertebra. The fibres of the muscles have the same direction as the external intercostal layer, of which they seem to be the continuation. Levatores costarum extend from transverse processes to ribs.

In some of the lower muscles a few of the fibres are continued beyond one rib to that next succeeding. These longer slips have been named *levatores longiores costarum.* Other elevator muscles.

* The *external intercostal muscle* is continued backwards along the ribs, as far as the tubercle, where they join the elevator muscle. Beneath this outer muscle are the intercostal nerve and artery. Outer intercostal muscle.

Dissection. — To trace the anterior and posterior divisions of the dorsal nerves to their origin in a common trunk, cut through the elevator of the rib and the external intercostal muscle in one or more spaces. The intercostal artery, with its posterior branch, is exposed at the same time. Dissection.

Dorsal nerve has

* The *dorsal nerves* split in the intervertebral foramina into anterior and posterior divisions.

posterior

* The *posterior* is directed backwards, internal to the anterior costo-transverse ligament, and has been already examined (p. 371.).

and anterior trunk.

* The *anterior* is named intercostal, in consequence of its position between the ribs. Its anatomy is learnt in the dissection of the thorax (p. 349.).

Intercostal artery.

* The *intercostal artery* has an almost exact correspondence with the dorsal nerve in its branching and distribution.

CHAPTER VI.

DISSECTION OF THE SPINAL CORD AND ITS MEMBRANES.

THE spinal cord is lodged in the canal formed by the bodies and plates of the vertebræ, and gives origin to the different spinal nerves. It is invested by prolongations of the membranes of the brain, which form sheaths around it, and support it in its large canal.

Cord is contained in spinal canal, invested by membranes.

Dissection.—To expose the external membrane of the cord, open the spinal canal by sawing through the arches of the vertebræ on each side close to the articular processes, after the muscle is removed from the bones. The cuts of the saw should extend to the lower end of the sacrum, but not higher in the neck than the fourth cervical vertebra. As it is difficult to use the saw in the hollow of the lumbar region, a chisel and mallet will be found useful to divide the plates of the vertebræ. When the spinal canal is opened, the tube of dura mater will be seen to be covered by some fat, especially at the lower part, and some veins. The fat is to be scraped away with the handle of the scalpel, and the lateral prolongations through the intervertebral foramina are to be defined.

Dissection to expose dura mater.

MEMBRANES OF THE CORD.—Three membranes envelop the cord like the brain, viz. an external tube of dura mater, an internal sheath of pia mater, and an intervening arachnoid or serous membrane.

Three membranes of the cord.

The *dura mater* of the cord forms a strong tube, which is prolonged from that lining the interior of the skull. The capacity of the sheath is much greater than is necessary for enveloping the cord; and the size of the sheath is also larger in the neck and loins than in the back. On the outer aspect the dura mater is smooth, when a comparison is made between it and that in the skull, for it does not act as a periosteum to the bones. Between it and the surrounding bones

Dura mater surrounds cord loosely, and is slightly connected with bones around.

are some vessels and fat, but it is connected to the posterior common ligament of the vertebræ by a few fibrous bands.

It gives offsets on spinal nerves

On each side the dura mater furnishes offsets to the different spinal nerves issuing by the intervertebral foramina; and inferiorly these several offsets form small tubes which enclose the sacral nerves, and lie for some distance within the spinal canal.

and one central inferior piece.

In the midst of these tubes, into which the dura mater is divided below, will be seen a slender impervious cord, that descends from the lower part of the dura mater to the end of the spinal canal, and is blended with the periosteum covering the back of the coccyx.

Its vessels.

Vessels. — The *arteries* of the dura mater are derived from the intraspinal branches of the vertebral, intercostal, and lumbar arteries. The *veins* open into the veins in the spinal canal.

Dissection to remove cord

Dissection. — The tube of the dura mater with the contained cord is next to be removed from the body. For this purpose cut through the lateral processes in the intervertebral apertures, and detach the central prolongation from the coccyx. Next cut across the cord and its membranes as high as the canal is opened, and remove them by cutting the bands that attach the dura mater to the ligament of the vertebræ.

and to expose next covering.

When the cord is taken out, place it on a piece of board or on the table, with the lateral offsets widely separated, and divide the dura mater along the middle as far as the small median cord before referred to. This membrane is to be raised whilst it is being cut through, to avoid injuring the loose arachnoid membrane that envelopes the cord. Lastly, draw outwards the dura mater, and fasten it back with pins.

Arachnoid membrane has a

The *arachnoid membrane* is the thin serous covering of the cord which is immediately beneath the dura mater. Like the corresponding membrane in the skull, it invests the nervous centre, and lines the dura mater; but the visceral layer around the cord is much looser than the same part around the brain.

parietal or attached layer, and

The outer or *parietal* layer is inseparably joined to the inner surface of the dura mater, and gives to that membrane the shining appearance.

a loose or visceral layer.

The inner or *visceral* layer surrounds the cord loosely, so as to leave a considerable interval between the two (subarachnoid space): at the lower part of the spinal canal this loose sheath is much the largest, and envelops the mass of nerves that form the cauda

equina. As the different spinal nerves extend to the intervertebral foramina they receive sheaths from the loose or visceral part of the arachnoid membrane, and retain the same till they perforate the dura mater.

Between it and cord is subarachnoid space.

Dissection. — The subarachnoid space of the cord may be made evident, either by cutting through the visceral layer and placing the handle of the scalpel beneath it, or by placing a detached piece of the cord in water, with the posterior aspect uppermost, and blowing air beneath the serous membrane.

To expose subarachnoid space.

The *subarachnoid space* is situate between the loose or visceral part of the arachnoid membrane and the spinal cord invested by pia mater. Larger at the lower than at the upper part of the spinal canal, the space contains a special fluid (subarachnoid); and it communicates with the cavity in the interior of the brain by the aperture in the fourth ventricle. Crossing the space are bundles of fibrous tissue, especially at the posterior part of the cord, where they are collected into an imperfect partition or septum along the middle line. In the space are seen likewise the serrations of the ligamentum denticulatum, and the roots of the spinal nerves, with some vessels.

Subarachnoid space is largest below, contains a fluid, and communicates with cavities of brain.

There is an imperfect septum behind.

Dissection.— For the purpose of seeing the next covering of the cord with the ligamentum denticulatum, the dura mater should be slit both before and behind, and fastened outwards. The arachnoid membrane is then to be taken away.

Dissection of next covering.

The *pia mater* is much less of a vascular membrane on the spinal cord than on the brain. Thicker and more fibrous in its nature, the membrane closely surrounds the cord, and furnishes offsets to the roots of the spinal nerves. Where the spinal cord ceases, viz. about the lower part of the body of the first lumbar vertebra, the investing tube of the pia mater is suddenly reduced in size, and has the appearance of a round fibrous cord. This cord-like part of the pia mater is unprovided with nervous substance, except for a short distance, and is blended with the central prolongation of the dura mater, on a level with the upper part of the sacrum. It serves to fix the lower end of the medulla, and has been named, from that circumstance, the central ligament of the

Pia mater supports the cord

and ends inferiorly in a fibrous piece, which is called central ligament.

cord. A vein and artery accompany this fibrous piece, and thus mark it out from the surrounding nerves. The outer surface of the pia mater is rough. Along the front of the membrane is a central anterior fibrous band (linea splendens, Haller); and on each side also the fibrous ligamentum denticulatum is attached to it. A prolongation of the membrane enters the anterior median fissure of the cord.

Fibrous bands are connected with it.

The *ligamentum denticulatum* is a white fibrous band on each side of the spinal cord, which is named from its serrated appearance. Situate between the anterior and posterior roots of the nerves, the band reaches upwards to the medulla oblongata, and ends inferiorly on the lower pointed part of the cord. Internally it is united to the surface of the pia mater. Externally it ends in a series of triangular or tooth-like projections, which are inserted into the dura mater about midway between the apertures of transmission of the roots of the spinal nerves. There are twenty or twenty-one of these denticulations, of which the first is attached to the dura mater opposite the margin of the occipital foramen, between the vertebral artery and the hypoglossal nerve, and the last is fixed opposite the last dorsal or the first lumbar vertebra. This fibrous band supports the spinal cord, and has received the name ligament from that circumstance.

One of these is the dentate ligament, which is fixed on one side to cord and on other to dura mater by points.

Number and attachment of these.

Dissection. — The arachnoid membrane is next to be taken from the fibrils of the roots of the nerves, and the fibrils are to be traced outwards to their transmission through apertures in the dura mater. One or more of the offsets of the dura mater, that have been cut of some length. should be laid open to show the contained ganglion. The student should define the ganglion, and should trace the roots of the nerves to their union beyond the ganglion.

Dissection of roots of nerves.

SPINAL NERVES. — The trunks of the spinal nerves are formed by the blending together of the roots (anterior and posterior) in the intervertebral foramina. The number of the nerves so constructed is thirty-one in all; and they are divided into cervical, dorsal, lumbar, and sacral groups, to which must be added one coccygeal nerve. In each group

Trunks of spinal nerves.

Number and arrangement in groups.

the nerves are equal to the number of the vertebræ, except in the cervical region of the spine, where there are eight nerves. In consequence of this peculiarity in the cervical nerves, the last is below the seventh vertebra; and it follows that the last nerve of each group will be below its corresponding vertebra.

Last nerve of a group below the vertebra.

ROOTS OF THE NERVES. — Each nerve is attached to the side of the spinal cord by an anterior and a posterior root, and its trunk is formed by the union of these, as before said, in the intervertebral foramen, or it may be in the spinal canal. The posterior root is marked by a ganglion, but the anterior root is aganglionic.

Each nerve has two roots, anterior and posterior.

The *posterior* or *ganglionic roots* surpass in size the anterior, and are formed by larger and more numerous fibrils. They are attached to the side of the cord in a line, between its posterior and antero-lateral pieces, which they keep without deviation even to the last nerve. In their course to the trunk of the nerve, the fibrils of the root pass outwards converging to an aperture in the dura mater opposite the intervertebral foramen; as they approach that aperture they are collected into two bundles which, lying side by side, receive a sheath from the dura mater, and enter the intervertebral ganglion. From the dissection that has been made, the ganglion is seen to be bifid at the inner part, where it is joined by the fibrils of the root, as if there were two ganglia, one for each bundle of fibrils, which became blended at their outer ends.

Posterior root is larger than anterior.

Its fibres are collected into two bundles

that end in the intervertebral ganglion.

Besides the general fact, that the posterior root is larger than the anterior, there is a difference in size to be noted between the fibrils of the posterior root in the different groups of the nerves.

Difference in the several groups.

In the cervical nerves the fibrils of the posterior root increase in size from vertebra to vertebra; but in the suboccipital or first nerve the posterior is smaller than the anterior root. In the dorsal nerves the posterior fibrils are smaller than in the cervical, and, if the large first nerve is excepted, they vary but slightly in size from above downwards. In the lumbar and sacral nerves the fibrils are the largest, supposing the last sacral and the coccygeal nerve not to be included in this general statement, for

Relative size in cervical, dorsal, lumbar, and sacral.

in these last the fibrils are smaller than in any other nerves of the spinal cord.

Anterior root is without ganglion.

The *anterior* or *aganglionic roots* arise from the side of the cord by filaments that are attached irregularly, and approach inferiorly the centre of the front of the cord. Taking the same direction as the posterior root, the fibrils enter a distinct opening and sheath of the dura mater, and passing over the ganglion of that root become blended beyond the ganglion to form one trunk. Occasionally the filaments of the anterior root are not confined to one nerve, but come from the nerve above or below it. The same peculiarity is seen in the posterior roots, viz. the passage of filaments between contiguous roots.

Its fibres pass through a separate opening in dura mater, and join posterior root beyond ganglion.

Differences in these roots

There are some differences to be observed in the anterior as well as in the posterior roots, with respect to the size of the fibrils of one part of the cord, when compared with those of another.

in the cervical,

dorsal, lumbar, and sacral nerves.

In the cervical nerves the anterior roots increase successively in size, and their fibrils are smaller in proportion to the posterior than in any other group of the spinal nerves. In the dorsal, lumbar, and sacral nerves there is the same gradation in size as in the fibrils of the posterior root, viz. the dorsal fibrils are smaller than the cervical, and the lumbar and sacral are the largest of all. Of course the last sacral and the coccygeal nerve form exceptions among the anterior as amongst the posterior roots.

The roots of the nerves are oblique in the canal; least in the cervical;

more in the dorsal;

and still more in the lumbar and sacral nerves,

Length and inclination of the roots.—The distance between the place of origin and the aperture of transmission of the roots of a spinal nerve increases from the upper to the lower end of the cord, so that the following peculiarities are to be recognised in each of the groups of nerves:—In the upper cervical nerves both roots are directed horizontally to their ganglia, and are very short; but in the lower nerves the roots have to pass obliquely downwards for the length of a vertebra, before they arrive at the ganglia. In the dorsal nerves the fibrils are more oblique, and run downwards by the side of the cord for the distance of two vertebræ before they reach the intervertebral foramen. In the lumbar and sacral nerves the roots are the longest, and become more and more oblique until at last they have a vertical

direction. As the cord ceases opposite the first lumbar vertebra, the long roots of the lumbar and sacral nerves surround it, and give it some resemblance to a horse's tail, so that the term "cauda equina" has been applied to it.

Where they form cauda equina.

Situation of the ganglia.—Commonly the ganglion on the posterior root of each nerve is lodged in the intervertebral foramen; and the trunk of the nerve bifurcates at the same spot into an anterior and a posterior division. But deviations from this arrangement are found in the following nerves:—

Ganglia on the roots. Situation in intervertebral foramen,

The first two cervical nerves have in each instance the ganglion on the posterior arch of the corresponding vertebra, and the anterior and posterior divisions diverge from the ganglion in that situation.

except in first two cervical,

In the sacral nerves the ganglia are contained in the spinal canal, and the union of the roots in the trunk also takes place within the canal. The primary divisions of the nerves issue by the apertures in the front and back of the sacrum.

and the sacral nerves.

The roots of the last sacral and of the coccygeal nerve are also united in the spinal canal, and the anterior and posterior divisions of each trunk escape by the lower aperture of that canal. The ganglion on the posterior root of the coccygeal nerve is placed about the middle of its length.

Peculiarities of branches in two last nerves.

VESSELS OF THE SPINAL CORD.—The arteries on the surface of the cord are anterior and posterior spinal.

Arteries of cord

a. The *anterior spinal artery* occupies the middle line of the cord beneath the fibrous band before alluded to in that position. Commencing at the medulla oblongata by the union of two small branches of the vertebral artery (p. 165.), the vessel is continued to the lower part of the cord by a series of anastomotic branches, which are derived from the vertebral and ascending cervical arteries in the neck, and from the intercostal and lumbar arteries in the dorsal and lumbar regions. The branches of this artery ramify in the pia mater, and are then distributed to the substance of the cord, some entering the anterior median fissure. Inferiorly it supplies the roots of the nerves forming the cauda equina, and ends on the central fibrous prolongation of the cord.

Anterior spinal, a single artery, which comes from vertebral, and is continued by anastomotic branches. Termination.

Posterior arteries are two; lie on sides of cord; their distribution; are continued along cord like anterior.

b. The *posterior spinal arteries*, one on each side, are continued from the upper to the lower part of the cord behind the roots of the nerves. Dividing into small branches, the vessels of opposite sides form a free anastomosis around the posterior roots, and some offsets enter the fissure of the cord. These vessels begin superiorly by offsets from the vertebral artery, and their continuity is maintained by a series of anastomotic branches, which run along the spinal nerves, and are furnished from the same source as the twigs that reinforce the anterior spinal artery.

Veins pass from spinal canal. Termination at top of cord.

The *veins* of the spinal cord are very tortuous, and form a plexus on the surface. At intervals, larger trunks arise which accompany the spinal nerves to the intervertebral foramina, and end in the veins outside the spinal canal. Near the top of the cord the veins are united into two or more small branches that terminate in the inferior cerebellar, or the petrosal sinuses, after communicating with the vertebral veins.

Situation of the cord.

The SPINAL CORD (medulla spinalis) is the cylindrical elongated part of the cerebro-spinal centre that is enclosed within the spinal canal. Invested by the membranes before examined, this body occupies about two-thirds of the length of the spinal canal, and is much smaller than the bony case that surrounds it.

Its extent varies below. Length. Inferior termination in the adult and in the embryo.

The extent of the cord is from the level of the atlas to the lower border of the first lumbar vertebra, but its termination inferiorly may be a little higher or lower than that spot. Its length is usually about sixteen or seventeen inches. Superiorly the cord joins the medulla oblongata; and inferiorly it becomes pointed, being sometimes marked by one or two swellings, and ends by a fibrous prolongation of the pia mater (central ligament of the cord). In the embryo, before the fourth month, the medulla reaches all the length of the spinal canal, but it then gradually recedes from below as the surrounding bones increase in size, until it takes the position it has in the adult.

Its size is increased where the

The size of the spinal cord is much increased opposite the origin of the nerves for the supply of the limbs. There are therefore two enlargements on it: one corresponds to the lower

cervical vertebræ, reaching as high as the third; the other is smaller, and is on a level with the last dorsal vertebra. In the cervical enlargement, the greatest thickness is from side to side; but in the inferior swelling the measurement of the cord is greatest from before backwards. nerves of the limbs are attached.

Anterior aspect distinguished from posterior.

Whilst the pia mater remains on the cord, the anterior surface is distinguished from the posterior by the position of the central fibrous band and the anterior spinal artery, and by the anterior roots approaching the middle line towards the lower end.

Dissection to see constituents of cord.

Dissection.—For the examination of the structure the student should possess a piece of the cord which has been hardened in spirit, for that which is obtained from the spinal canal at this period is not fitted for the purpose of dissection. Supposing the pia mater removed from the surface of the cord, without the roots of the nerves being detached, the student will be able to observe the following facts:—

Fissures of the cord are.

FISSURES OF THE CORD.—On both the anterior and posterior aspects of the cord is a median longitudinal cleft (anterior and posterior median fissures), which mark its division into halves; and along the line of the posterior roots of the nerves on each side is another slit (lateral fissure).

anterior median,

a. The *anterior median fissure* is wider than the posterior, and penetrates about one-third of the thickness of the cord. It is lined by a fold of the pia mater, and is deepest towards the lower end of the cord. The medullary substance of the surface enters the fissure, lining it; and in the bottom of the cleft the white fibres are transverse, and are pierced by apertures for bloodvessels.

posterior median,

b. The *posterior median fissure* is not so wide or well marked as the anterior, but it is best seen at the upper part of the cord. The vessels of the posterior aspect of the cord enter this fissure, and white substance is continued into it from one half to another of the medulla.

and lateral fissure.

c. The *lateral fissure* (posterior) is situate along the line of attachment of the fibrils of the posterior roots. It reaches inwards to the grey matter of the medulla, as will be afterwards seen.

Supposed

Some anatomists describe another *lateral fissure* (an-

other lateral fissure.

terior) along the line of origin of the anterior roots, but there is not any cleft in that situation.

The cord is divided into

Divisions of the Cord. — Each half of the cord, viz. from the anterior to the posterior median fissure, is divided into two parts by the lateral slit or fissure. The piece in front of that line (posterior roots of the nerves) is called the antero-lateral column, and the piece behind, the posterior column.

antero-lateral column

a. The *antero-lateral column* includes rather more than two-thirds of the surface of the half of the cord, extending backwards to the posterior roots of the nerves, and gives attachment to the anterior roots. By some anatomists it is divided into two parts (an anterior and a lateral column) by a supposed fissure along the attachment of the anterior roots.*

and posterior column.

b. The *posterior column* is situate between the posterior roots of the nerves and the central fissure along the posterior aspect of the cord. On the surface of this division, near the median fissure, is a slight groove or furrow, marking off a slender piece, the *posterior median column*, which terminates superiorly in the posterior pyramid of the medulla oblongata. This separation is best seen in the cervical part of the cord.

Cord consists of grey and white matter;

Structure of the Cord. — A horizontal section of the medulla spinalis shows it to be composed of white medullary substance, containing within it grey or cineritious matter: and to consist of two lateral parts or halves, which are united internally by a central piece or commissure.

Grey matter has two semilunar masses, and a transverse piece.

a. The *grey matter* in the centre of the cord is disposed in the form of two semilunar masses, one in each half, which are connected by a central transverse piece. Each semilunar mass has its convexity turned towards its fellow, and is joined by the connecting transverse part (grey commissure). The posterior extremity or cornu of the mass is long and

* For the sake of making the description of the fibres of the medulla oblongata more intelligible (p. 176.), mention is made of three columns, anterior, middle, and posterior; but the two first are included in the antero-lateral division.

pointed, and projects to the surface of the cord at the lateral fissure; but the anterior cornu is larger and shorter than the posterior, and is directed forwards towards the line of attachment of the anterior roots, without, however, reaching the surface of the cord. The extremity of the anterior cornu is uneven at the margin; and at the end of the posterior cornu the grey matter is swollen, and appears somewhat transparent (substantia cinerea gelatinosa).

Disposition of the semilunar mass.

b. The *white matter* forming the circumference of the spinal cord is composed of nerve fibres disposed longitudinally in bundles, so as to give passage to intermediate vessels. In each half of the cord the white matter is separated into two parts by the projection to the surface of the posterior cornu of the crescentic mass of grey matter between the antero-lateral and the posterior column. The posterior column of the cord, with its small slender piece, is now seen to be wedge-shaped, as it projects inwards between the posterior median fissure and the posterior cornu of the grey matter. The antero-lateral column is partly divided into two (anterior and lateral) by the projecting anterior cornu of the grey crescentic-shaped mass. It must be further remarked that the white matter of one half of the cord is continued to the opposite across the median fissures.

White matter surrounds the grey.

White fibres separated by grey matter.

The anterior mass again partly divided.

c. The *commissural* or *central* piece connecting the halves of the cord is formed of an internal layer of grey matter, which is covered in front and behind by white substance.

Piece between halves of the cord

The grey matter is the transverse band (grey commissure) that connects the masses in the halves of the cord. The white layers are derived from the white matter lining the median fissures: they are named anterior and posterior white commissures, and the anterior layer is the thickest of the two.

is grey inside, and white in front and behind.

Deep Origin of the Nerves.—Respecting the ultimate destination of the filaments of the roots of the spinal nerves, there is much uncertainty. In each root some filaments are connected with the white matter of the cord, but in the posterior root they enter, in addition, the grey matter.

Roots of the nerves in the cord.

The *anterior roots* are situate over the anterior cornu of

Attach-

ment of anterior roots. the grey substance, and are connected with the white matter of the antero-lateral column of the cord, both in front of and behind the place of attachment to the surface. According to those anatomists who divide the antero-lateral column into two, they arise from the white fibres of both the anterior and lateral columns of the cord. It is said by Bellingeri that the filaments enter the anterior cornu of the grey crescentic mass.

Attachment of posterior roots. The *filaments of the posterior roots* enter the lateral fissure of the cord, and are connected with the extremity of the posterior cornu of the grey crescent. They are connected likewise with the white fibres of the posterior part of the antero-lateral column (the lateral column of some anatomists), but they join also the posterior column at some spots along the cord.

Ultimate termination doubtful. The termination of the nerve tubes of the roots after they enter the cord is very doubtful. It is supposed that those entering the white substance ascend along the cord; whilst those in the grey matter are considered either to end in it, or to traverse it and join the other white fibres.

Vessels of the spinal canal. Intraspinal Vessels. — The arteries in the interior of the spinal canal supply the cord and the bodies of the vertebræ. The veins form a remarkable plexus within the canal, but much of this is destroyed in opening the canal and removing the cord.

Source of the intra-spinal arteries. The *intraspinal arteries* supply branches to the spinal cord, and are derived from the arteries along the sides and front of the spinal column, viz. from the vertebral and ascending cervical, from the intercostal, and from the lumbar and lateral sacral.

Distribution to the vertebræ and the cord. As each artery enters the spinal canal by the intervertebral foramen, it divides into two branches, upper and lower: these branches are directed, one upwards and the other downwards, behind the bodies of the vertebræ contiguous to the intervertebral foramen, and outside the edge of the posterior common ligament of the spine, to join in anastomotic loops with offsets of the intra-spinal artery above and below. These loops extend from one intervertebral foramen to another. and furnish branches to the

periosteum, and the bodies of the vertebræ on their posterior surface, as well as anastomotic twigs to connect the arches across the vertebræ.

The *intraspinal veins* are not seen unless they are injected. They consist of two anterior longitudinal veins, which extend the whole length of the spinal canal behind the bodies of the vertebræ; of veins from the bodies of the vertebræ; and of a plexus of veins beneath the plates or arches of the vertebræ. Veins within the spinal canal are large.

a. The *anterior longitudinal* veins are close to the bodies of the vertebræ, one on each side of the common ligament of those bones, and are irregular in outline, owing to certain constrictions near the intervertebral foramina. They receive opposite the body of each vertebra the vein from that bone; and they send outwards through the intervertebral foramina branches of communication with the veins outside the spine in the neck, the dorsal region, and the loins. Anterior longitudinal are on bodies of vertebræ.

b. Veins of the bodies of the vertebræ. — Within the canals in the bodies of the vertebræ are contained large veins, that join on the front of each vertebra with veins in that situation, and unite together behind into one trunk that passes from the bone by the large aperture on the posterior surface. Escaped from the bone, the trunk divides into two branches that pass, one to the right another to the left, to open into the large longitudinal veins. Veins of the vertebræ.

c. The *posterior spinal veins* form a plexus between the dura mater and the laminæ of the vertebræ. A large vein may be said to lie on each side of the middle line, which joins freely with its fellow, and with the anterior longitudinal vein by lateral branches. Into this plexus the small veins on the outside of the laminæ pour their contents. Branches from these vessels are directed to the intervertebral foramina, where they end in the veins at the roots of the transverse processes. Posterior spinal veins are in contact with laminæ.

CHAPTER VII.

DISSECTION OF THE PERINÆUM.

SECTION I.

PERINÆUM OF THE MALE.

The dissection is to be made soon.

THE examination of the perinæum should be made before the dissection of the abdomen, because the distinctness of many of the parts is destroyed soon after death. Before the body is placed in the position suited for the dissection, the student may practise passing the catheter along the urethra.

Place the body in position,

Position of the body.—Whilst the body lies on the back it is to be drawn to the end of the dissecting table, till the buttocks hang slightly over it. A moderate sized block is then to be placed beneath the pelvis, to raise the perinæum to a convenient height. Afterwards the legs are to be raised, and fastened out of the way by the following means:—Bend the thighs upon the trunk, and bend the knees at the same time; make one or two turns of a cord round the bent knee (say the right), carry the cord beneath the table, encircling the opposite limb at the same part, and fasten it finally round the right knee. When the position is arranged, let the student raise the scrotum, and place a small bit of cotton wool or tow within the anus, but let him avoid distending the rectum.

and fasten upwards the legs.

The surface presents

Marking of the surface.—The space in the male between the scrotum in front and the thighs and buttocks on the sides and behind, is of a dark colour, and covered with hairs. About its centre is the aperture of the anus, which is posterior to a line extended from the anterior part of one ischial tuberosity to another. In front of the anus the surface is slightly convex, and presents a longitudinal prominent line (raphé), which divides the space into two parts. Between the anus

the anus,

a raphé,

and the tuberosity of the ischium the surface is somewhat hollowed, especially in emaciated bodies, and corresponds to the space of the subjacent ischio-rectal fossa. The margin of the anal aperture has naturally numerous converging folds, which are more or less obliterated by the position of the body and the distension of the rectum; and projecting oftentimes through and around the opening are some dilated hæmorrhoidal veins (hæmorrhoids).

hollow on side of anus.

and folds and veins around that opening.

Boundaries.—The perinæal space corresponds to the inferior aperture or the outlet of the pelvis, and its limits may be ascertained by referring to a dry or prepared pelvis, on which the ligaments remain entire. Beginning in front, the student will find the arch of the pubes and the subpubic ligament; and at the posterior part, the tip of the coccyx. On each side, from before backwards, is that part of the innominate bone which consists of the ramus of the pubes and the ramus and tuberosity of the ischium; and still further back is the great sacro-sciatic ligament extending from the tuberosity of the ischium to the tip of the coccyx. The space included within these boundaries has the form of a lozenge, and measures about four inches from before backwards, and three inches from one tuberosity to another of the ischium. A line from the front of the tuberosity of one side to that of the other will divide the perinæal space into two triangular parts. In the anterior (urethral half) are contained the roots of the penis and their muscles; the urethra, with its muscles, vessels, and nerves; and the triangular ligament. The posterior part (anal half) is occupied by the lower end of the rectum, with its muscles, vessels, and nerves. The depth of the perinæum from the anus to the bladder may be said to be about three inches, but this measurement varies much in different bodies.

Bounding parts around, same as those of outlet of pelvis.

Form of the space and measurements.

A line between the tuberosities divides it into two.

Depth of the space.

Dissection of the anal half of the space.—Before the student proceeds with his dissection, let him trace with the finger the boundaries of the perinæum on the body. Afterwards make an incision across the perinæum at the front of the anus, and extend it rather beyond the tuberosity of the ischium on each side. A little behind the tip of the coccyx, divide the skin in the same direction and for the same distance. Then connect the two transverse cuts by

Dissection

carrying the knife along the middle line and around the anus. Raise and throw outwards the two flaps of skin from the middle line. In detaching the skin from the margin of the anus, the superficial sphincter muscle will be exposed. The dissector should first trace that muscle back to the coccyx, and then forwards beneath the remaining piece of skin. The next step is to bring into view a large hollow (ischio-rectal fossa) between the side of the rectum and the tuberosity of the ischium, clearing the fat out of it on the left side without reference to the vessels and nerves, and making a special dissection of these on the opposite side.

of sphincter ani. Difference in exposing the ischio-rectal fossa.

Dissection of left ischio-rectal fossa, To clean out the fat from the left fossa, begin at the outer margin of the sphincter, and from that point proceed forwards and backwards. In front the dissection should not extend beyond the anus, whilst behind it should expose the margin of the gluteus maximus. On the inner side are the fibres of the levator ani (sometimes very pale) and of the coccygeus; and on the outer boundary the pudic vessels should be exposed, as they lie in a canal formed by fascia.

and of that on right side, seeking vessels and nerves. On the opposite side it is not necessary to clean the muscular fibres when following the vessels and nerves. Beginning at the outer border of the sphincter, the student will find the inferior hæmorrhoidal vessels and nerve, which may be traced outwards to their trunks (pudic vessels and nerve): some branches of the nerve are directed forwards and join with two other nerves, the superficial perineal and inferior pudendal. In the posterior angle of the space is a small offset of the fourth sacral nerve; and sometimes external to it one or more branches of the sciatic nerve and artery are found, turning round the border of the gluteus. Near the front of the fossa is a superficial perineal artery and nerve (of the pudic); and the last, after communicating with the hæmorrhoidal nerve, leaves the fossa in front. The trunks of the pudic vessels and nerve may be laid bare on the outer wall.

Situation of the fossa. The term *ischio-rectal fossa* is applied to the space between the rectum and the ischial part of the innominate bone. Irregular in shape, it is larger behind than before,

Dimensions. Boundaries. and is filled by a soft granular fat. Its width is about one inch, and its depth about two inches. Internally, the space is bounded by the levator ani muscle, and slightly by the sphincter; and externally by the obturator muscle and the fascia covering it. In front it is limited by the triangular ligament (to be afterwards seen); and behind by the great

sacro-sciatic ligament and the largest gluteal muscle. Along the outer wall the pudic vessels and nerve lie in a tube of fascia, being one inch and a half from the margin of the tuberosity of the ischium; but towards the front of the space they are nearer to the edge of the ramus of that bone. Crossing the centre of the space are the inferior hæmorrhoidal vessels and nerve, — branches of the pudic. At the anterior part, for a short distance, is a superficial perineal nerve (of the pudic), and in the posterior part is a small branch of the fourth sacral nerve. Into this space the surgeon sinks his knife in the first incisions in the lateral operation of lithotomy, and as the knife is carried from before backwards, it divides the superficial hæmorrhoidal vessels and nerve.

Pudic vessels on the outer wall, and nerves in the space.

First cut in lithotomy enters this space.

Muscles.—Connected with the lower end of the rectum are three muscles, two sphincters (external and internal) and the levator ani.

Muscles of rectum.

The external sphincter (sphincter ani externus) is a flat, thin, orbicular muscle, which is pointed in front and behind, and surrounds the lower part of the rectum. Like other orbicular muscles, the fibres form elipses around a central aperture. The muscle *arises* posteriorly from the tip of the coccyx by a fibrous band, and from the superficial fascia in front of that bone. The fibres pass forwards to the anus, where they separate to encircle that aperture, and having again united in front of it, are *inserted* into the superficial fascia and the central point of the perinæum. The sphincter is close beneath the skin, and partly conceals the levator ani. The outer border projects over the ischio-rectal fossa, and the inner is contiguous to the internal sphincter.

External sphincter surrounds rectum.

Origin.

Insertion.

Connections.

The internal sphincter (sphincter ani internus) is situate around the extremity of the intestine, internal to the preceding muscle, and is seen by removing the mucous membrane. The fibres of this muscle are pale, and of a finer texture than those of the other sphincter; they encircle the lower part of the rectum in the form of a band, and are inserted in front into the central point of the perinæum. The

Internal sphincter is a pale band around the end of the gut.

Inserted into common point.

muscle may be considered to be only a band of the circular fibres of the large intestine.

Insertion of levator ani

The LEVATOR ANI muscle can be seen now only in part, and the external sphincter should be detached from the coccyx, that its insertion may be more apparent. The muscle descends from the inner aspect of the innominate bone to be *inserted* along the middle line, from the coccyx to the central point of the perinæum. The most posterior fibres are connected to the side of the coccyx; and between that bone and the rectum the muscles of opposite sides are united in a central tendinous line. The middle fibres are blended with the side of the intestine (rectum). Whilst the anterior are joined with those of the opposite muscle, in front of the rectum, in the central point of the perinæum. This muscle bounds the ischio-rectal fossa on the inner side.

to coccyx, to tendon in front of it; to rectum, and to centre of perinæum.

Arteries of the space.

ARTERIES.—The inferior hæmorrhoidal is the only named branch of the pudic artery that is now exposed. Some other small branches of the pudic and sciatic are also seen.

Inferior hæmorrhoidal

The *inferior hæmorrhoidal artery* arises from the trunk of the pudic, internal to the tuberosity of the ischium, and divides into branches that pass inwards across the ischio-rectal fossa to end in the skin and the sphincter and levator ani muscles. On the rectum this artery anastomoses with the middle hæmorrhoidal artery of the internal iliac, and with the artery of the opposite side. In a well-injected body, some cutaneous branches are seen to run forwards to the anterior part of the perinæum, and communicate with the superficial perinæal artery. A *vein* accompanies the artery.

ends on rectum and in its muscle. Branch of vein.

Other offsets of pudic.

Other small branches of the pudic artery cross the front of the fossa for the supply of the anterior part of the levator ani muscle.

Branches of the sciatic.

Branches of the sciatic artery appear on the inner aspect of the gluteus maximus at the back of the fossa; some end in that muscle, and others are continued round its border to the surface.

Nerves.

NERVES.—The branches of nerves are the inferior hæmorrhoidal, an offset of the fourth sacral nerve, and some branches of the small sciatic nerve.

Inferior hæmorrhoidal is with artery of

The *inferior hæmorrhoidal nerve* is most frequently a branch of the pudic, though it may have a separate origin from the sacral plexus. Accompanying the artery of the same name across the

ischio-rectal fossa, it reaches the margin of the anus, where it terminates in offsets to the integument and the sphincter muscle. Other cutaneous offsets of the nerve turn forwards over the fossa, and communicate with the superficial perinæal nerve, and with the inferior pudendal (of the small sciatic) on the margin of the thigh. *Same name. Termination*

The *hæmorrhoidal branch* of the *fourth sacral nerve* reaches the ischio-rectal fossa by piercing the fibres of the coccygeus, or by passing between that muscle and the levator ani. Appearing in the posterior part of the fossa, close to the coccyx, the nerve ends by supplying the external sphincter and the integument behind the anus. *Branch of sacral nerve supplies sphincter.*

One or two *cutaneous branches* of the *small sciatic nerve* turn round that part of the lower border of the gluteus, which is now exposed in their course to the integuments on its surface. *Cutaneous offsets of small sciatic.*

Dissection of the urethral half of the perinæal space.—To raise the skin from the anterior part of the perinæum, make a transverse cut at the back of the scrotum, and continue the same for a short distance (two inches) on each thigh. A second incision along the middle line will allow the flaps of skin to be reflected. *Incisions to raise the skin.*

To define a partition of the superficial fascia between the perinæal space and the thigh, which is connected with the rami of the pubes and ischium, it will be necessary to remove, on the left side, the superficial fascia from the fascia lata of the thigh, external to the line of the bones before mentioned. In repeating the dissection on the right side, the student should seek the inferior pudendal nerve, which pierces the fascia lata about one inch anterior to the tuberosity of the ischium, and the same distance from the margin of the ramus of that bone; and should trace its junction with the inferior hæmorrhoidal nerve in the superficial fascia. Afterwards this nerve is to be followed forwards to where it enters beneath the piece of the superficial fascia in the middle line. *Define partition between thigh and perinæal space, and seek inferior pudendal nerve.*

To separate the superficial fascia covering the front of the perinæal space, blow it up by means of a blow-pipe, introduced beneath it at the posterior part. Each side is to be inflated to demonstrate the fact that a partition exists in the middle line. The student is next to cut through the superficial fascia, on the left side, from the scrotum to the ischio-rectal fossa, and to remove some cellular membrane, in order to expose the line of attachment of that fascia to the bones externally, and to the triangular ligament posteriorly. The septum along the middle line should also be defined. *Blow up superficial fascia, and reflect it.*

The *superficial fascia* of the anterior half of the perinæum *Superfi-*

cial fascia. is continuous with that of the rest of the body, extending on each side to the thigh, in front to the scrotum, and backwards around the anus. Its depth and the quantity of fat in it will vary with the condition of the body. It resembles the superficial fascia of the groin and upper part of the thigh, in having two strata; — one is a subcutaneous fatty part; and the other is a deeper membranous layer, which is of limited extent, and is connected with the firm subjacent structures. Air blown beneath the fascia has been seen to pass only to the scrotum; and this direction is given to it by the connections of the deeper layer on the under surface. An examination of these connections shows this layer to have the following attachments: — On the outer side it is fixed to the rami of the pubes and ischium, external to the line of the crus penis and its muscle, extending as low as the tuberosity of the ischium. Posteriorly the fascia dips down to join the triangular ligament of the perinæum; but in front it is unattached, and is continued to the scrotum and the penis. Thus a pouch is formed over the anterior half of the perinæal space by the marginal attachment of the superficial fascia. From the under surface of the fascia a septum dips downwards, and divides the subjacent space into two parts; but anteriorly this partition is less perfect or disappears. Should urine be effused beneath the membranous part of the fascia, the fluid will be directed forwards, through the scrotum, to the penis and the front of the abdomen.

Its thickness varies. Resembles that of groin, in having two layers. Its connections with parts around. Forms a pouch, open in front; this divided by a septum. Course of effused urine.

Dissection of nerves and vessels on right side. *Dissection.* — Cut through the superficial fascia on the right side of the perinæum in the same manner as on the left side, and then trace out the superficial vessels and nerves beneath it. One long slender artery is the superficial perinæal, which gives a transverse branch near its commencement. Sometimes there are two long superficial branches. There are two superficial perinæal nerves with the artery, and the inferior pudendal is to be traced forwards to the scrotum. Communications are to be found between these anteriorly, and between one of the perinæal and the inferior hæmorrhoidal posteriorly; and all are to be followed back to their origin.

Superficial vessels of pudic. ARTERIES. — The superficial arteries beneath the fascia are branches of the pudic, viz. superficial and transverse perinæal, and are, as before said, two or three in number.

The *superficial perinæal* branch is given off from the pudic in front of the hæmorrhoidal. Perforating usually the base of the triangular ligament, it turns forwards over or under the transverse muscle, and beneath the superficial fascia, to the back of the scrotum, where it ends in flexuous branches for that part. As the vessel lies beneath the fascia, internal to the rami of the ischium and pubes, it supplies offsets to the muscles beneath; and in front it anastomoses with the external or superficial pudic arteries. Sometimes there is a second superficial perinæal branch. Superficial perinæal ends in scrotum, and supplies the muscles.

At the origin of the superficial perinæal, some other *muscular branches* pass inwards to the front of the levator ani. Other muscular branches.

The *transverse artery* of the perinæum arises at the same spot as the preceding, or from it, and is directed transversely to the middle of the perinæal space, where it is distributed to the integuments and the transverse muscles. It anastomoses with the one of the opposite side. Transverse artery.

Branches of *veins* correspond to those of the artery, and open into the trunk of the pudic vein. Veins with the arteries.

NERVES. — There are three long cutaneous nerves of the scrotum: the inferior pudendal from the small sciatic, and two superficial perinæal branches from the pudic nerve. Cutaneous nerves of scrotum.

The *superficial perinæal nerves*, two in number, are named anterior and posterior from their relative position at their origin. They arise from the lower division of the pudic nerve. Two superficial perinæal.

a. The *posterior branch* appears in the front of the ischio-rectal fossa, and entering beneath the superficial fascia, is continued forwards with the artery of the same name to the back of the scrotum. Whilst in the fossa the nerve gives inwards an offset to the integuments in front of the anus, which communicates with the inferior hæmorrhoidal nerve. Posterior crosses over fossa to the scrotum,

b. The *anterior branch*, appearing somewhat farther forward than the other, passes either over or under the transverse muscle, and accompanies the posterior branch to the scrotum. At its origin muscular offsets are furnished to the levator ani muscle. Other muscular branches arise from the pudic nerve at the same spot, but these will be afterwards examined. and anterior has same anatomy as posterior;

The superficial perinæal branches communicate with one another, and the posterior one is joined by the inferior pudendal nerve. At the scrotum they are distributed by both are joined and distributed to scro-

tum and penis. long slender filaments, which reach as far as the under surface of the penis. In the female these nerves supply the labia pudendi.

Inferior pudendal nerve. The *inferior pudendal nerve* is a branch of the small sciatic; it pierces the fascia lata about one inch in front of the tuberosity of the ischium, and coursing forwards along the inner part of the thigh, enters beneath the superficial fascia of the perinæum. Finally, it passes forwards with the superficial perinæal nerves, and ends in scrotum, and joins superficial perinæal. ends in the outer part and front of the scrotum. A communication takes place between this nerve and the posterior superficial perinæal branch. In the female the inferior pudendal nerve is distributed to the labium.

Other offsets of small sciatic. On the surface of the thigh some other filaments (internal branches) of the small sciatic nerve may be observed.

Dissection of some muscles of the urethra and penis. *Dissection.*—Take away the superficial fascia from the anterior half of the perinæal space, as well as the vessels and nerves that have been examined. Then expose the muscles beneath by removing a thin aponeurotic layer from them. In cleaning the muscle in the middle line (accelerator urinæ), trace out especially a posterior and an anterior fasciculus of fibres prolonged from it. On the outer side of the space is the erector penis, and passing horizontally between the other two is the transverse muscle. The dissector should seek out, on the right side, the branches of nerves to the muscles: to the erector muscle there is a separate branch, and beneath the transversalis is the offset that supplies the other two muscles and the urethra.

Three muscles above triangular ligament. MUSCLES. — Superficial to the triangular ligament are three muscles of the anterior half of the perinæal space, viz. the erector penis, the accelerator urinæ, and the transversalis perinæi. Other muscles of the urethra are concealed by the triangular ligament.

Erector penis. The ERECTOR PENIS is the most external of the three muscles, and is narrower at each end than in the middle. Origin. It covers the crus penis, and its fibres *arise* from the inner surface of the tuberosity of the ischium behind the crus of the penis, and from the ramus of the pubes on each side of the crus. Superiorly the muscle ends in two slips, of which Insertion. the outer is the larger, that are *inserted* by aponeuroses, one into the inner and the other into the outer aspect of the Covers crus penis. penis. The muscle rests on the crus penis and the bone.

The ACCELERATOR URINÆ muscle lies on the urethra along the middle line of the perinæum. The muscles of opposite sides join through the interposition of a median tendon. Each muscle *arises* from the common tendon along the middle line, and from the central point of the perinæum. From that origin the fibres are directed outwards, and give rise to a thin muscle which is curved around the convexity of the urethra, and has the following *insertion*: — The most posterior fibres are lost on the anterior surface of the triangular ligament. The anterior fibres, which are the longest and best marked, turn round the penis to be inserted on its outer aspect anterior to the erector; and, according to Kobelt*, send a tendinous expansion over the dorsal vessels of the penis. Whilst the middle or intervening fibres turn round the urethra (between it and the body of the penis), and join in a central tendon with the muscle of the opposite side. The accelerator muscle covers the bulb and the urethra for two inches beyond the triangular ligament. If the muscle is cut through on the right side, and turned off the urethra, the insertion on the opposite aspect of that tube will be visible.

Accelerator urinæ.

Origin at middle line.

Insertion by three parts.

Covers the urethra, and surrounds it in a sling.

The TRANSVERSALIS PERINÆI is a small thin muscle which lies across the perinæum, opposite the base of the triangular ligament. *Arising* by a tendon from the inner aspect of the ascending ramus of the ischium, the fibres run inwards, and join in the central point of the perinæum with the muscle of the opposite side, and with the sphincter ani and the accelerator urinæ. Behind this muscle the superficial fascia dips down to join the triangular ligament.

Transversalis perinæi.

Origin.

Ends in central point of perinæum.

Sometimes there is a second small muscular slip anterior to the transversalis (transversalis alter), which throws itself into the accelerator muscle.

Accessory transversalis.

The three muscles now described enclose a triangular space, of which the accelerator urinæ forms the inner side, the erector penis the outer side, and the transversalis perinæi muscle the base. In the area of this interval is

A triangular space between the three muscles described.

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* Die Männlichen und Weiblichen Wollust-Organe, von G. L. Kobelt, 1844.

the triangular ligament of the urethra, with the superficial perinæal vessels and nerves. Into the posterior part of this space the knife enters during the deeper incisions in the operation of lithotomy; and as the instrument is carried backwards in the direction of the external incision, it will cut the transverse muscle and artery, and possibly the superficial perinæal vessels and nerves.

The knife enters this in lithotomy.

Dissection to see triangular ligament.

Dissection of the triangular ligament.—On the left side remove completely the accelerator urinæ from the front of the ligament, and the erector penis from the crus of the penis. The same proceeding may be followed on the right side, but the dissector should observe, before cutting away the muscles, the branches of the nerve to them. One nerve is also to be traced to the urethra. Detach the crus penis from the bone on the left side, and, if necessary, on the right side also, and the triangular ligament will come into view. Be careful not to cut the triangular ligament when separating the crus penis from the bone, and not to injure the terminal branches of the pudic artery, after it appears on the surface of the ligament near the pubes.

Triangular ligament of urethra.

Extent and form.

Attachments.

The *triangular ligament of the urethra* (perinæal aponeurosis) occupies the anterior part of the pubic arch, and supports the urethral canal. The ligament is of a triangular form, and about one inch and a half in depth. On the sides it is fixed to the rami of the pubes and ischium beneath the crura penis. Above (its apex) the ligament is prolonged on the front of the symphysis pubis, where it joins the periosteum; and below or behind (its base) it is connected in the middle line with the central point of the perinæum, whilst the lateral parts are sloped downwards from that spot towards the bone. A thin fascia that covers the surface of the levator ani muscle in the ischio-rectal fossa is connected to the lower border. The anterior surface is in contact with the muscles in the anterior half of the perinæal space, and the superficial fascia is united to this surface near the lower border. Perforating the ligament about one inch below the symphysis pubis is the canal of the urethra, but the margin of the opening that gives passage to that tube is blended by means of fibres with the tissue of the urethra. About half an inch below the symphysis pubis is the aperture for the

Anterior surface.

Apertures in it for urethra,

dorsal vein of the penis; and external to this, near the bone on each side, the terminal branches of the pudic nerve and artery to the dorsum of the penis perforate the ligament. The triangular ligament is composed chiefly of transverse fibres, but it is so thin as to allow the vessels and muscular fibres to be seen through it. Beneath the ligament will be found the muscles of the membranous part of the urethra, the artery of the bulb, and Cowper's glands.

for dorsal vein of penis, and for dorsal vessels and nerves.

Consists of fibres

Parts beneath.

In some anatomical works the triangular ligament of the urethra is said to consist of two layers (anterior and posterior) that enclose the membranous part of the urethra with its muscular fibres. The structure, which has been described as the posterior layer, is part of the fascia lining the interior of the pelvis, and is not perforated by the canal of the urethra.

Different view of triangular ligament.

Dissection.—On the left side cut through with care the attachment of the triangular ligament to the bone, and raise and turn inwards the piece of membrane. By a little careful dissection, and the removal of some veins, the following parts will be exposed:—Near the base of the ligament is a narrow transverse muscle, which is directed to the bulb of the urethra; higher than this, and coming downwards to the urethra from behind the ramus of the pubes, is the fasciculus of fibres of the compressor urethræ muscle, which surrounds the membranous part of the urethra. Beneath the bone (rami of the ischium and pubes) are the pudic artery and nerve, the former giving its branch to the bulb. By passing deep enough, the dissector will be able to see the layer of the pelvic fascia that separates these parts from the cavity of the pelvis. Near the pubes is the subpubic ligament.

Dissection of muscles beneath triangular ligament.

MUSCLES.—The muscles connected with the membranous part of the urethra are two in number: a deep transverse muscle, and a constrictor of the urethral passage.

Muscles of urethra.

The DEEP TRANSVERSE muscle of the perinæum (elevator urethræ, Santorini) is a thin flat band, on a level with the base of the triangular ligament. It *arises* externally from the ramus of the ischium, and occasionally from that of the pubes, and is directed inwards between the tip of the bulb

Deep transverse.

Origin.

and the membranous part of the urethra, to join (sometimes by a tendon) the muscle of the opposite side, and to be attached by some fibres to the side of the bulb. This muscle conceals Cowper's gland near the bulb, and is frequently placed over the artery of the bulb.

Termination.

Constrictor of urethral passage has two parts.

The CONSTRICTOR MUSCLE of the urethra (constrictor isthmi urethralis) encloses the membranous part of that tube from the bulb to the front of the prostate. It consists of two parts, viz. of superficial transverse fibres, both above and below the urethra, which are connected on each side to the ramus of the os pubis, and of a deeper layer of circular fibres.

Transverse part arises from pubes, and ends in middle line, over and under urethra.

a. The *transverse* part of the muscle arises by aponeurotic fibres from the descending ramus of the pubes for the distance of half or three quarters of an inch; but this attachment is not evident except the muscle is exposed from behind. From this origin the fibres pass inwards, and separate near the urethra into two layers, which are directed one over the other under that canal, and unite in the middle line, sometimes by tendinous bands, with corresponding parts of the muscle of the opposite side. Or the fibres may be described as extending across the perinæum from one lateral attachment to another, and enclosing the tube of the urethra in their passage (Müller).

Circular part.

b. The *circular* part surrounds the urethra between the bulb and the prostate; its fibres do not reach outwards to the bone, but are blended with the transverse fibres of the other part of the muscle.*

Cowper's glands. Situation and size.

The *glands of Cowper* will be found by cutting through the transverse muscle: they are situate, one on each side, close behind the bulb, and below the membranous part of the urethra. Each gland is about the size of a pea, and is made up of many small lobules. Connected with each is a minute duct, nearly an inch in length, which perforates obliquely the wall of the urethra (corpus spongiosum), and

Length and termination of the duct.

* For farther information respecting this muscle, consult the Septemdecim Tabulæ of Santorini; a Treatise of J. Müller, Ueber die Organischen Nerven der erectilen Männlichen Geschlechts Organe, &c.; a Paper by James Wilson in the first volume of the Med. Chirur. Transactions; and the Work of Mr. Guthrie, On the Anatomy and Diseases of the Neck of the Bladder and Urethra.

opens into the urethral canal about an inch in front of the triangular ligament: the aperture of the duct in the ordinary condition of the parts does not admit a bristle. These bodies are sometimes so small as to escape detection, and they appear to decrease in size with advancing age.

Dissection.—The student may complete the examination of the perinæum by tracing out the pudic vessels and nerve, and their remaining branches. From the point of division into two branches beneath the crus (dorsal branch of penis and branch of the corpus cavernosum), the artery is to be followed backwards along the outer wall of the right ischio-rectal fossa. The pudic nerve is exposed at the same time, but should any of the branches be cut away, the corresponding ones may be sought on the opposite side. Dissection of the pudic vessels and nerve.

The *pudic artery* is a branch of the internal iliac, which, after entering the perinæal space through the small sacro-ischiatic notch, is distributed to the perinæum and the genital organs. Entering the posterior part of the ischio-rectal fossa, the artery extends forwards along the outer wall in an aponeurotic canal, being attached to the fascia covering the obturator muscle, and at the height of one inch and a half above the tuberosity of the ischium. At the base of the triangular ligament the vessel is near the margin of the ramus of the pubes; it then ascends along that bone nearly to the subpubic ligament, where it perforates the triangular ligament, and divides into the artery of the body, and that of the dorsum of the penis. Pudic artery courses along ramus of ischium and of pubes, and ends on penis.

The *branches* of the vessel in the perinæal space are numerous. Some of them have been examined, viz. inferior hæmorrhoidal, transverse perinæal, and superficial perinæal; the remaining are subjoined:— Branches not yet seen are

The *artery of the bulb* of the urethra is a branch of considerable size, and arises near the base of the triangular ligament. Passing almost transversely inwards beneath the ligament, and about half an inch from the base, the artery reaches the bulb of the urethra, and enters its spongy structure. Near the urethra it furnishes a small branch to Cowper's gland. artery of bulb beneath triangular ligament.

The distance of this branch from the base of the ligament depends upon its origin; for if the vessel arises farther back than usual, it may be altogether below the base of the ligament, but if Its situation varies.

it arises more anteriorly than the base of the ligament, or from an accessory pudic branch, its position will be higher than the level of the bulb. From the size of the vessel its place is important in the operation of lithotomy. In the case first mentioned, it would be liable to be cut across, whilst in the last it would be altogether out of the way of the knife.

The importance of this in lithotomy.

Artery of body of penis.

The *artery of the cavernous structure* of the penis (art. corporis cavernosi) is one of the terminal branches of the pudic. At first this small vessel lies between the crus penis and the ramus of the pubes, but it soon enters the cavernous structure of the penis, and ramifies in it.

Artery of dorsum of penis.

The *dorsal artery of the penis* runs upwards between the crus penis and the bone, and reaches its destination by passing between the layers of the suspensory ligament of the penis. Its distribution with the accompanying nerve is noticed at page 419. It is much smaller in the female than in the male.

Pudic vein.

The *pudic vein* has the same connections, and the same branches as the artery, with the exception that the dorsal vein of the penis does not join it.

Pudic nerve is with artery

The *pudic nerve* is derived from the sacral plexus, and distributes offsets corresponding to the branches of the pudic artery. The nerve enters the posterior part of the ischio-rectal fossa, and supplies there the inferior hæmorrhoidal (p. 398.) and a large perinæal branch. Much diminished in size, it continues with the artery without branching, pierces the triangular ligament of the urethra, and is continued onward to the dorsum of the penis with the dorsal branch of the pudic artery. Its termination is described at page 419.

and ends like it on penis.

Perinæal branch

The *perinæal branch* supplies the superficial perinæal nerves, which have been already described (p. 401.), and extends forwards below the pudic artery, nearly to the base of the triangular ligament, where it ends in offsets to the muscles, as well as to the bulb of the urethra.

ends in the following

muscular offsets.

Muscular branches.—One turns outwards to enter the under surface of the erector penis; others pass beneath the transversalis, supplying it and the accelerator urinæ; and one or two other slender filaments pierce the triangular ligament, and supply the muscles beneath it.

Nerve of the bulb.

The *nerve of the bulb* is a long slender branch that supplies, like the artery, the spongy structure investing the canal of the urethra.

Some of the filaments of distribution run for some distance on the surface before entering the corpus spongiosum urethræ.

Parts cut through in the operation of lithotomy. — A review of the relative position of the parts in the perinæum will bring to mind the structures that must be cut in reaching the bladder, and those that are to be avoided.

Parts cut in lithotomy.

In making the external incisions the knife is entered in the middle line of the perinæum, one inch in front of the anus, and is drawn backwards on the left side to midway between the tuberosity of the ischium and the anus. It has been before said that the skin and superficial fascia, and the inferior hæmorrhoidal vessels and nerves, lying across the ischio-rectal fossa, would then be cut. In the subsequent incisions to reach the staff, when the knife is introduced into the anterior part of the wound, the transverse perinæal muscle and artery, with the lower part of the triangular ligament, and possibly the superficial perinæal vessels and nerves, are divided. The membranous part of the urethra and the muscular fibre about it are cut, when the knife is placed within the groove of the staff. Lastly, as the knife is pushed along the staff into the bladder, it incises in its progress the membranous part of the urethra, and part of the substance of the prostate gland with the large veins around it.

In cutting from the surface to the staff, and in running knife along staff into bladder.

The several parts to be avoided in the stages of the operation are the following: — In the first incisions in the ischio-rectal fossa, the rectum will be cut if the knife is turned inwards across the intestine, instead of being kept parallel with it, and if the gut is not kept out of the way with the fore-finger of the left hand. The pudic vessels on the outer wall of the ischio-rectal fossa may be wounded near the anterior part of that hollow, where they approach the margin of the ramus of the pubes; but, posteriorly, they are very securely lodged inside the projection of the tuberosity of the ischium. Whilst making the deeper incisions to reach the staff, the bulb and its artery lie immediately in front of the knife, and will be cut if the incisions are made too far forward; but the vessel must necessarily be cut, when it arises farther back than usual, and crosses the front of the ischio-

Parts to be avoided are rectum, pudic vessels, bulb and its artery,

ejaculatory duct. rectal fossa in its course to the bulb of the urethra. In dividing the prostate gland the edge of the knife is to be turned outwards and downwards, in the direction of a line from the urethra through its left lateral lobe, so as not to injure the ejaculatory duct below. Division of capsule of the prostate gland. The whole of the prostate and its capsule are not to be cut through, otherwise the urine may be effused beneath the peritoneum.

When the dissection of the perinæum is completed, the flaps of skin are to be fastened together, after some preservative fluid has been used, and the limbs are to be put down.

Section II.

PERINÆUM OF THE FEMALE.

Perinæum of female has special parts. In the female the perinæum differs from the same region in the male more in the external form than the internal anatomy; but it has special parts distinguishing it, viz. the aperture of the vagina surrounded by its sphincter, and the aperture of the vulva with the labia.

Along middle, apertures of anus and vulva. *Surface marking.* — On the surface of the perinæal space in the middle line, there are two apertures, viz. those of the anus and vulva; the former is situate rather farther back than in the male, and the vulva is in the situation of the scrotum of the other sex. Bounding the vulva are the labia majora, one on each side. Parts within vulva. Within the vulva, at the upper part, is the clitoris, with two small membranous folds, labia minora, extending downwards from it. Below the clitoris is the small aperture of the urethra; and still lower down is the vagina, whose aperture is sometimes partly closed by a thin piece of membrane, the hymen.

Parts bounding space are same in both sexes. *Boundaries.* — The boundaries of the perinæum are alike in both sexes. But in the female the outlet of the pelvis, corresponding to the perinæum, is larger than in the male; it equals about four inches in the transverse direction, and its width is nearly the same as the antero-posterior measurement. In this sex the perinæum is not so deep as in the male.

Dissection.—The steps of the dissection are much the same in both sexes, and the same description will serve generally for the perinæum of the male and female. Make, first, the dissection of the ischio-rectal fossa, and afterwards examine the muscles, vessels, and nerves of the posterior half of the perinæal space. (See description of the MALE PERINÆUM, p. 395.) Take first ischio-rectal fossa.

Next raise the skin from the anterior half of the perinæal space, as in the male, making the transverse incision in front at the anterior part of the vulva. Examine the attachments of the superficial fascia, and trace the cutaneous vessels and nerves beneath it (p. 399.). Then examine anterior half of perinæum.

Superficial fascia.—The description of this structure in the male will serve for the anatomy of it in the female with this modification; that here it is less perfect and of less extent, in consequence of the aperture of the vulva, and is continued forwards through the labia majora to the inguinal region. Superficial fascia.

Dissection.—Remove the labia and the superficial fascia, and follow the sphincter vaginæ muscle around the opening of the vagina. The two other muscles now exposed (transversalis perinæi and erector clitoridis) resemble those in the male. Dissection of the muscles.

The SPHINCTER VAGINÆ is an orbicular muscle around the orifice of the vagina. Posteriorly it is attached to the central point of the perinæum, where it mixes with the sphincter ani and transversalis muscles, and its fibres are directed forwards, some on each side of the vagina, to be *inserted* into the body of the clitoris. Sphincter vaginæ. Origin. Insertion.

The ERECTOR CLITORIDIS resembles the erector of the penis in the male, though it is much smaller. The *transversalis* is similar to the same muscle in the male. The one description will suffice for these parts in both sexes (p. 402.). Erector clitoridis. Transversalis.

Dissection.—Detach the erector and crus clitoridis from the bone, and remove the outer fibres of the sphincter vaginæ to see the triangular ligament of the urethra. To expose triangular ligament.

The *triangular ligament* transmits the urethra, but is not quite so strongly marked as in the male; its extent is partly interrupted behind by the large aperture of the vagina (p. 404.). Triangular ligament.

Dissection.—Cut through the ligament in the same way as in the male, and dissect out the deep transverse muscle with the pudic vessels and nerve, and their branches. Afterwards follow back the trunks of those vessels and of the pudic nerve. To see muscles of urethra.

Deep transverse muscle. The DEEP TRANSVERSE MUSCLE (depressor urethræ, Santorini) has the same origin externally as in the male, and it meets its fellow at the middle line. Santorini described the muscle as passing over, instead of below the urethra; hence the name given to it by its discoverer.

Constrictor urethræ. The CONSTRICTOR MUSCLE of the urethra resembles that of the male in its origin from the pubes, and its disposition around the urethra.

Pudic vessels. The description of the *pudic artery* (p. 407.) will serve for both sexes, except that the branch in the female, corresponding to the artery of the bulb, is furnished to the vagina. The terminal branches are much smaller too in the female.

Pudic nerve. The *pudic nerve* has the same peculiarity as the artery with respect to the branches to the vagina, and the smaller size of the terminal part of the nerve on the clitoris.

CHAPTER VIII.

DISSECTION OF THE ABDOMEN.

SECTION I.

WALL OF THE ABDOMEN.

THE dissector may here be reminded that he has to proceed as far as the end of Section 3. before the body is turned for the dissection of the back. Directions for the dissection.

Position. — The body is sufficiently raised by the blocks placed beneath the thorax and buttocks, as directed for the dissection of the limbs; but the dissector should see that the chest is higher than the pelvis. After inflating the abdomen by an aperture through the umbilicus, let the following markings on the surface be first attended to. Position of the body.

Surface-marking. — On its anterior aspect, the abdomen is for the most part convex, especially in fat bodies, whilst on the sides, between the ribs and pelvis, the surface is somewhat depressed. Along the middle line is a slight groove, corresponding to the linea alba, which presents about its centre the excavation of the umbilicus. Inferiorly the groove ceases a little above the pelvis, in the prominence of the pubes; and superiorly it subsides in a hollow (epigastric fossa) below the ensiform cartilage. On each side of the middle line is the projection of the rectus muscle, and this is intersected in well-formed bodies by two or three transverse depressions. Appearances on the front of the abdomen.

Beneath the eminence of the pubes the student will be able to recognise with his finger the symphysis pubis, and to trace outwards from it the crest of the os pubis which leads to the spinous process. If the finger is still carried outwards to the crest of the innominate bone, it will detect the firm band of Poupart's ligament, and sometimes a few inguinal Projections of pubes and Poupart's ligament.

Abdominal rings. glands. Rather above and to the outside of the pubes, the opening of the external abdominal ring may be felt, and the prominence of the spermatic cord descending to the testicle may be recognised. The position of the internal abdominal ring is still to the outer side, or midway between the symphysis pubis and the crest of the innominate bone, and a little above Poupart's ligament. Attached to the front of the symphysis pubis in the male are the penis and the scrotum.

Raise the skin *Dissection.* — The incisions requisite to raise the skin from the sides and front of the belly are the following: — one cut is to extend outwards over the side of the chest from the ensiform cartilage to about midway between the sternum and the spine; a second incision is to be begun in the middle line midway between the umbilicus and the pubes, and to be carried outwards to the crest of the ilium, and along the crest till it ends opposite the first cut; lastly, the ends of the two incisions are to be connected along the side of the chest and belly. Raise the piece of skin thus marked out towards the middle line, and seek the undermentioned cutaneous vessels and nerves in the fat. The lateral cutaneous nerves, which are five or six in number, appear along the side of the abdomen, in a line with the corresponding nerves of the thorax; they give offsets backwards, and are then directed forwards with small cutaneous arteries. The lower branch from the last dorsal nerve crosses the crest of the ilium near its front; and still farther back on the crest is the cutaneous branch of the ilio-hypogastric nerve. Near the middle line the small anterior cutaneous nerves will be found; these are uncertain in number and size, and are directed outwards in the integuments. and seek cutaneous nerves.

Take the skin from the groin. Next throw downwards, on both sides, the piece of skin that covers the lower part of the abdomen or the groin, by means of an incision along the middle line to the root of the penis, dissecting the cutaneous vessels and nerves on the right side, and the superficial fascia on the left.

Seek vessels and nerves in right groin. To make the necessary dissection on the right side, raise the fascia that is superficial to the vessels, and throw it downwards to the thigh in the same manner as the piece of skin; the vessels now exposed are the superficial pudic on the inside, the superficial epigastric in the centre, and there may be an offset of the superficial circumflex iliac artery on the outside. Some inguinal glands are seen along the line of the reflected fascia. Two cutaneous nerves are to be sought; one (ilio-inguinal) comes out through the abdo-

minal ring, and descends to the thigh; the other (ilio-hypogastric) appears in the superficial fascia above, and rather outside the abdominal ring.

To show the existence of two layers of fascia, on the left side, one above and one beneath the vessels, raise a layer from the vessels by means of one transverse cut from the spine of the ilium to the middle line, and not much above Poupart's ligament, and another along the middle line to the pubes. The position of the subjacent vessels marks the depth of the layer; and when these are reached, raise and throw down towards the thigh a flap of the fascia like the piece of skin. To define the thinner under-layer, cut it across in the same manner as the other layer, and then detach it with the vessels on it from the tendon of the external oblique muscle. This layer, like the preceding, is to be traced around the cord to the scrotum; and as the student follows it downwards, he will find it connected with Poupart's ligament, and inseparably joined with the fascia lata close below that structure. Separate superficial fascia into layers in left groin.

The *superficial fascia* over the greater part of the abdomen is a single layer between the skin and the special fascia investing the muscles, but in the groin it is seen to be divided into a subcutaneous and a deep layer by the vessels and glands. Superficial fascia is divided into two layers.

a. The *subcutaneous layer* contains the fat, and therefore varies in appearance and thickness in different bodies; for in a fat body it is divisible into several layers, whilst in a thin one it is somewhat membranous near the thigh. This layer is continuous with the superficial fascia of the thigh, and with that of the rest of the abdomen; and if it is traced to the limb, it is found to be separated from Poupart's ligament by the superficial vessels and glands. Internally it is continued to the penis and scrotum, where it loses its adipose tissue; and after investing the testicle, the layer is prolonged to the superficial fascia of the perinæum. The subcutaneous layer contains fat, except in the penis and scrotum.

b. The *deeper layer* of the superficial fascia (aponeurosis of the fascia lata, Scarpa) is thinner and more membranous than the other, and is closely united to the tendon of the external oblique by fibrous bands, especially towards the linea alba. Like the subcutaneous part of the fascia, this layer is continued upwards on the abdomen, and inwards to the penis Deeper layer is thin and membranous;

is joined to Poupart's ligament, and ends on fascia lata.

and the scrotum; but it extends only a very short distance in the limb. As it passes over Poupart's ligament it is closely joined to that structure by a thin membrane, and ends a little below the ligament on the fascia lata across the front of the thigh. The piece that is continued to the scrotum around the cord becomes very thin and acquires special characters; and having passed through the scrotum it reaches the perinæum in union with the other layer, where it has attachments to the subjacent parts as before specified (p. 399.). When urine escapes from the urethra, it is directed through the scrotum, by reason of the attachments of the superficial fascia, and then upwards along the cord to the abdomen. From the disposition of the deep layer across the thigh, it is evident that the fluid cannot pass down the limb, whilst its progress over the front of the abdomen is uninterrupted.

Special characters and disposition in scrotum and perinæum.

Attachments determine course of effused urine.

In the female.

In the female the superficial fascia of the groin is separable into two layers, as in the male; and the disposition of each is nearly the same as in the other sex; but the part that in the one sex is continued to the scrotum, in the other enters the labium in its course to the perinæum. In the female the round ligament of the uterus is lost in the superficial fascia of the groin.

Cutaneous nerves

are derived from two sources.

Cutaneous Nerves. — The nerves in the superficial fascia are chiefly derived from the trunks of the lower five or six intercostal nerves;—the branches along the side of the belly (lateral cutaneous) are offsets from those nerves, whilst the branches along the front (anterior cutaneous) are the terminal parts of the same trunks. Cutaneous offsets from two branches of the lumbar plexus (ilio-hypogastric and ilio-inguinal) are seen at the lower part of the abdomen.

Lateral cutaneous of the intercostal,

which divide into

The *lateral cutaneous nerves* of the abdomen emerge in a line with the same set of nerves on the thorax, the lowest being the most posterior. As soon as they appear on the surface they divide, with the exception of the last, into an anterior and a posterior branch.

posterior and

a. The *posterior branch* is of small size, and is directed backwards to the integuments over the latissimus dorsi muscle.

anterior branch.

b. The *anterior branch* runs forwards in the superficial fascia nearly

to the edge of the rectus muscle, and supplies the integuments on the side of the belly.

Last dorsal nerve.—The lateral cutaneous branch of this nerve is larger than the rest, and does not divide like the others. After piercing the fibres of the external oblique muscle, the nerve is directed over the crest of the ilium to the surface of the gluteal region.

Last dorsal nerve.

The *anterior cutaneous nerves* of the abdomen reach the surface by piercing the sheath of the rectus. On the surface they turn outwards towards the lateral cutaneous nerves. The number and the place of exit of these small nerves from the abdominal wall are very uncertain.

Anterior cutaneous nerves of intercostal.

The *ilio-hypogastric nerve* is distributed on the surface by two parts: one lies over the crest of the ilium (iliac branch), the other is on the lower part of the abdomen (hypogastric branch).

Ilio-hypogastric of lumbar plexus.

a. The *iliac branch* crosses the crest of the innominate bone behind the last dorsal nerve, and enters the integument of the gluteal region; its size and its position on the bone are dependant upon the bulk and the situation of the branch of the dorsal nerve.

Iliac branch.

b. The *hypogastric branch* pierces the aponeurosis of the external oblique muscle above the external abdominal ring, and is distributed, as the name expresses, to the integument of the hypogastric region of the abdomen.

Hypogastric branch.

The *ilio-inguinal nerve* becomes cutaneous through the external abdominal ring, and having perforated the deeper layer of superficial fascia, descends to the scrotum and the upper part of the thigh.

Ilio-inguinal nerve of the plexus.

Cutaneous Vessels.—Some cutaneous vessels are found with both sets of nerves on the abdomen: with the lateral cutaneous nerves are branches from the intercostal arteries, and with the anterior cutaneous are offsets from the internal mammary and epigastric vessels. In the groin, where they are dissected on the right side, are three small superficial branches of the femoral artery, viz. pudic, epigastric, and circumflex iliac.

Vessels from two sources.

a. The *lateral cutaneous arteries* have the same anatomy as the nerves they accompany. These small vessels are directed towards the front of the abdomen on the surface of the external oblique muscle, and end about the outer edge of the rectus muscle. The *anterior cutaneous* vessels are irregular in number and in position

Both lateral and anterior cutaneous.

like the nerves. After piercing the sheath of the rectus, they run outwards with the nerves towards the other set of branches.

From femoral artery these branches:

The *superficial branches* of the *femoral artery* turn upwards from the thigh, between the layers of the superficial fascia, and ramify in the integuments of the genital organs, and lower part of the abdomen. The greater part of these vessels appears in the dissection of the thigh.

External pudic.

The *external pudic branch* (superficial) crosses the spermatic cord, to which it gives offsets, and ends in the integuments of the under part of the penis.

Superficial epigastric.

The *superficial epigastric branch* ascends over Poupart's ligament near the centre, and is distributed in the superficial fascia as high as the umbilicus. Its size varies very much.

Circumflex iliac.

The *circumflex iliac branch* usually lies below the level of the crest of the ilium, and sends only a few offsets upwards to the abdomen.

Veins.

Small *veins* accompany the arteries and join the internal saphenous vein in the thigh.

Inguinal glands.

The *glands of the groin* are three or four in number, and lie over the line of Poupart's ligament. They are placed between the two layers of the superficial fascia, and receive the lymphatics from the abdomen, from the upper and outer part of the thigh, and from the superficial parts of the genital organs. Their efferent ducts pass downwards to the saphenous opening in the thigh to enter the abdomen.

Ducts enter thigh.

Dissection of coverings of penis.

Dissection.—After the examination of the superficial fascia and its vessels and nerves on the abdomen, the student may make the dissection of the cutaneous coverings of the penis and scrotum. Divide therefore the skin along the dorsum of the penis, and throw it to each side, and then reflect the skin from the scrotum by means of a vertical incision on the left side.

Superficial fascia on penis and in scrotum.

On the *penis* the *superficial fascia* becomes very thin and membranous, and loses the fat that it possesses in most other parts of the body. The fascia that is continued to the scrotum becomes also thin, and of a reddish colour; and if it is cut through the student will see that the prolongation sent around the cord of one side does not communicate with the prolongation of the other side, and that the septum scroti is formed by the contact of the two pieces in the middle line.

Dissection. — Remove the cellular membrane from the root of the penis and from the front of the symphysis pubis, to expose the suspensory ligament of the penis. Afterwards follow forwards the dorsal arteries, nerves, and vein of the penis, by removing the superficial fascia.

Dissection of vessels and nerves.

The *suspensory ligament of the penis* is a band of fibrous tissue, of a triangular form, which is attached by its apex to the front of the symphysis pubis near the lower part. Widening as it descends, the ligament divides into two pieces, which are fixed to the upper surface of the body of the penis, and are prolonged on it for some distance. In the interval between the layers are the dorsal vessels and nerves of the penis.

Suspensory ligament of penis. Attachments. Contains vessels and nerves.

The *dorsal artery of the penis*, one on each side, is the terminal part of the pudic artery. Appearing between the layers of the triangular ligament, the vessel extends forwards on the dorsum of the penis as far as the corona glandis, where it ends in many branches which enter that structure. In this course the artery supplies the integuments and the body of the penis. This artery may be a separate branch of the internal iliac, and arrive at its destination by a course along the side of the prostate, and through the triangular ligament of the urethra.

Dorsal artery of penis, a branch of pudic. Peculiarities.

The *dorsal vein* of the penis is a single trunk, and commences by numerous branches from the prepuce and glans penis. The course of the vein is backwards by the side of the artery, between the layers of the suspensory ligament, and then through the triangular ligament of the urethra to join the prostatic plexus of veins. In its extent along the penis this vein receives branches from the corpus cavernosum.

Dorsal vein ends in prostatic plexus.

Each *dorsal nerve* of the penis takes the same course as the artery to the glans penis, and ends like it in numerous branches to that part. Moreover it furnishes a large branch to the corpus cavernosum penis, and other branches to the integuments of the dorsum, the sides, and the prepuce of the penis.

Dorsal nerve of pudic.

In the female these vessels are much smaller than in the male, and they occupy the upper surface of the clitoris.

Vessels on clitoris.

Dissection. — The surface of the most external muscle of the abdominal wall is next to be freed from superficial fascia on both sides of the body. Where the muscle is fleshy, viz. posteriorly, the knife is to be directed along the fibres. In front of a line

To expose external oblique muscle.

extended upwards from the anterior part of the crest of the ilium, the muscle presents a wide thin aponeurosis, which the dissector should not injure, especially at the upper part, where it is very thin over the margin of the ribs. On the right side define the margin of the external abdominal ring, to show the cord passing through it; and on the left side preserve a thin fascia (intercolumnar), that is connected with the margin of that opening. Lastly, the dissector should make evident the free margin of the external oblique muscle between the last rib and the crest of the ilium.

Three flat muscles in wall of abdomen

Muscles of the abdominal wall. — In the wall of the abdomen are three large flat muscles, which are named from their position to one another, and from the direction of their fibres. The most superficial muscle is the external oblique, the next one the internal oblique, and the last is the transversalis. Anteriorly they end in aponeuroses which are partly conjoined to incase the rectus and pyramidalis muscles. Posteriorly the transverse muscle ends also in a second aponeurosis (fascia lumborum), which encloses the quadratus lumborum muscle.

and their aponeuroses incase three vertical ones.

External oblique muscle is first.

The EXTERNAL OBLIQUE MUSCLE is fleshy on the side, and aponeurotic on the fore part of the abdomen. It *arises* by fleshy pointed digitations from the outer surface of the eight lower ribs, the five highest pieces alternating with similar parts of the serratus magnus, and the three lowest with the processes of origin of the latissimus dorsi muscle. From the attachment to the ribs, the fibres are directed over the side of the abdomen in the following manner: — the lower fibres descend almost vertically to be *inserted* into the anterior half of the crest of the ilium at its outer margin; whilst the upper and middle fibres are continued forwards, the one set horizontally, the other obliquely, to the aponeurosis on the front of the belly. The muscle is subcutaneous, and at its attachment to the ribs, the fibres are continuous with the external intercostal muscle. The posterior border is usually free between the last rib and the crest of the ilium, and is contiguous to the edge of the latissimus dorsi, so that a part of the internal oblique may be seen between them; but this border may be concealed by the latissimus dorsi muscle.

Origin from ribs.

Insertion into pelvis and linea alba.

Connections.

Aponeu-

The *aponeurosis* of the muscle occupies the anterior part

of the abdomen, in front of a line from the eighth rib to the crest of the ilium, and is rather narrower about the centre of the abdomen than either above or below. Along the middle line of the body this tendinous expansion ends in the linea alba,—the common point of union of the aponeuroses of opposite sides. Appearing through the aponeurosis, external to the linea alba, is a white line (linea semilunaris), corresponding to the outer edge of the rectus muscle; and crossing between those two lines are three or four whitish marks (lineæ transversæ). Numerous small apertures in the tendon give exit to cutaneous vessels and nerves. On the lower part of the abdomen the fibres of the aponeurosis are stronger and more separate than in the other parts, and are directed downwards and inwards to be fixed to the pubes, or collected in the firm band of Poupart's ligament, between the pubes and the crest of the ilium. Near the pubes is the aperture (external abdominal ring) which gives passage to the cord in the male, or the round ligament in the female.

rosis of the muscle covers front of the belly.

Is marked by linea alba, semilunaris, and transverse;

perforated by apertures;

ends below in Poupart's ligament;

gives passage to cord.

The following parts in connection with the aponeurosis of the external oblique muscle, are to be described with more detail.

Linea alba.—This is the central white line of the front of the abdomen, in which the aponeuroses of the muscles of opposite sides are united. It extends from the xiphoid cartilage to the pubes, and serves as a ligament between the thorax and pelvis. Its breadth is wider above than below, and it is perforated here and there by small apertures that allow masses of fat to protrude in some bodies. A little below the centre is the umbilicus, which projects now beyond the surface, though before the skin was removed there was a hollow corresponding to it. Through the umbilicus a piece of intestine may protrude from the abdomen, and give rise to umbilical hernia.

In the linea alba the aponeuroses are united.

In its middle is umbilicus.

External abdominal ring. — Towards the crest of the os pubis the fibres of the aponeurosis diverge to their attachment to separate points of that bone, and leave thereby the angular space of the external abdominal ring. This interval is somewhat triangular in form, with the base at the crest of the os pubis, and the apex pointing upwards and outwards. The long measurement of the aperture is about an inch, and

External abdominal ring.

Form and situation.

Size.

Inner side or pillar.

the transverse about half an inch. The inner margin (inner pillar) is thin and continuous with the rest of the aponeurosis; it is prolonged to the front of the symphysis pubis into which it is inserted, and on which it crosses over the corresponding piece of the aponeurosis of the opposite side.

Outer margin.

The outer or lower margin (outer pillar) is formed by the part of the aponeurosis named Poupart's ligament, and is attached to the spine or tuberosity of the os pubis: this margin is not straight like the inner, but is bent backwards so as to present a kind of groove for the spermatic cord.

A fascia prolonged from the opening.

A thin membrane (intercolumnar or spermatic fascia) obscures the sides of the opening, and is derived from some fibres (intercolumnar) on the surface of the aponeurosis.

The cord in male,

The ring gives passage in the male to the spermatic cord, and in the female to the round ligament; and each lies on the outer or lower pillar as it passes through, and obtains a covering from the intercolumnar fibres.

and hernial protrusion pass through.

Through the same aperture the inguinal hernia protrudes from the wall of the abdomen, receiving at the same time a covering from the intercolumnar fascia.

Intercolumnar fibres.

The *intercolumnar fibres* form a layer over the aponeurosis of the external oblique at the lower part of the abdomen, and bind together the parallel fibres of that aponeurosis, so as to form a resisting membrane.

Attachment inferiorly.

Here some of the fibres are connected by a pointed process with the outer third of Poupart's ligament, and extend back to the crest of the ilium.

They cross upper part of ring,

From this point the fibres diverge, and at the external abdominal ring they stretch from side to side (hence the origin of their name), and becoming stronger and aggregated together, close the upper part of that opening.

and produce the thin intercolumnar fascia.

Moreover they give rise to the membrane, *intercolumnar fascia*, which is prolonged from the margin of the abdominal ring. On the left side, where the fascia is entire, this thin covering will be manifest on the surface of the cord, or on the round ligament.

To see insertion of Poupart's ligament.

Dissection.—To see the attachments and connections of Poupart's ligament, it will be necessary to reflect the lower part of the aponeurosis of the external oblique muscle towards the thigh on both sides. For this purpose make one incision through the aponeurosis from the crest of the ilium nearly to the middle line.

Throw down piece of external oblique.

Detach the aponeurosis with the handle of the scalpel from the subjacent parts, and cut it vertically in the direction of a line to the symphysis pubis, when it cannot be separated farther from the

tendons beneath. After the triangular piece of the aponeurosis has been thrown to the thigh, dislodge the cord from the surface of Poupart's ligament to see the insertion of that band into the os pubis, and the fibres that ascend therefrom to the linea alba, and form the triangular ligament.

Poupart's ligament is the lower border of the aponeurosis of the external oblique muscle, which intervenes between the crest of the ilium and the pubes, and arches over the vessels and muscles that pass from the abdomen at this spot. Its external half is round and cord-like, and is attached to the anterior superior spine of the ilium; but the internal half widens as it approaches the pubes, and is inserted into the spine of the os pubis as well as into the pectineal line, external to that point of bone, for three quarters of an inch. When the ligament is in its natural position, the fibres that are connected with the pectineal line give rise to a triangular looking piece, with its base directed outwards, which is named *Gimbernat's ligament*. (See the Dissection of the THIGH.) The line of Poupart's ligament is not straight between its outer and inner attachments, but is curved downwards to the thigh, and retains this position as long as the fascia lata remains uncut. To the posterior surface, along the outer half, are united the internal oblique, cremaster, and transversalis muscles of the abdomen; and passing over the upper surface of the ligament at its inner end is the spermatic cord.

Poupart's ligament. Situation. Outer and inner attachments: last forms Gimbernat's ligament. Its direction, and parts in contact with it.

Triangular ligament.—From the insertion of Gimbernat's ligament into the pectineal line, some fibres are directed upwards and inwards to the linea alba, where they become blended with the other tendons. As the fibres ascend, they diverge and form a thin band, to which the term *triangular ligament* has been applied.

Triangular ligament.

Dissection.—On both sides of the body remove the remaining portion of the external oblique, to see the parts covered by it. Carry the scalpel through the digitations on the ribs back to the free border of the muscle, and then cut through the attachment to the crista ilii. Throw forwards the muscle as far as it is practicable, after the nerves that cross the crest of the ilium are dissected out; and take care neither to detach the rectus muscle from the ribs, nor to cut through the tendon of the internal oblique near the same part. By the removal of cellular membrane the following muscle and the nerves on its surface will be cleaned. At the

Dissection to expose internal oblique.

lower border of the internal oblique is the cremaster muscle, which should be defined.

Parts covered by external oblique. Beneath the external oblique is the internal oblique muscle, with the ribs and the intercostal muscles. At the lower part of the abdomen, this muscle conceals the cord and the branches of nerves from the lumbar plexus that are in the abdominal wall. The aponeurosis of the external oblique assists to form the sheath of the rectus.

Internal oblique muscle. The INTERNAL OBLIQUE MUSCLE is fleshy below and aponeurotic above, just the reverse of the preceding muscle; and its fibres (except the lowest) in ascending cross the direction of those of the external oblique. The muscle *arises* from the outer half of Poupart's ligament, from the anterior two thirds of the crest of the ilium, and from the fascia lumborum in the interval between the crest of that bone and the last rib. The fibres diverge on the abdomen to their destination. The most posterior fibres ascend to be *inserted* into the lower border of the cartilages of the four lower ribs, where they join the internal intercostal muscle of the two lowest spaces. The most anterior fibres (from Poupart's ligament) arch downwards and inwards over the spermatic cord, and are inserted into the crista of the os pubis, and into the pectineal line by a tendon (part of the aponeurosis), which is blended with a similar part of the transversalis muscle. The intervening fibres are continued into the aponeurosis on the front of the abdomen.

Origin from pelvis.

Insertion into the ribs and linea alba,

except lowest tibres.

Aponeurosis of the muscle. The *aponeurosis* of the muscle covers the anterior part of the abdomen from the pelvis to the chest, and is blended with the other aponeuroses in the linea alba. It is widest at the thorax, and is connected beneath the rectus muscle with the ensiform cartilage, and with the last true and the first false rib. Inferiorly it is fixed to the crest and the pectineal line of the os pubis, behind the insertion of Poupart's ligament into that bone. At the margin of the rectus the aponeurosis is divided into two pieces, which incase that muscle, and unite at its inner margin; but midway between the umbilicus and the pubes the aponeurosis is undivided, and lies in front of the rectus.

Attachments to chest and pelvis.

Divides to incase rectus.

The internal oblique is covered by the external oblique muscle. It is attached on all sides, except between Poupart's ligament and the os pubis, where it arches over the cord, and has the cremaster muscle contiguous to it. The parts covered by the internal oblique cannot be seen till the muscle is reflected. Parts covering internal oblique.

The CREMASTER MUSCLE, so named from suspending the testicle, is a fasciculus of fibres that lies along the lower border of the internal oblique muscle, but is separated from it by a cellular interval. Superiorly the muscle has attachments (internal and external) similar to those of the internal oblique. Its external fleshy part is attached to Poupart's ligament below the internal oblique, with which some of the fibres are connected, and it may also join the transversalis; but the inner part is small and pointed, and is fixed, chiefly by tendon, to the front of the os pubis and sheath of the rectus. Between those two fixed points the fibres descend on the front and sides of the cord, forming loops with the convexity downwards; and the lowest loops are connected with the tunica vaginalis testis, on its outer aspect. The muscular fibres are united by cellular membrane so as to give rise to a covering for the front of the cord, *fascia cremasterica*. Occasionally the fibres may be behind as well as on the sides and front of the cord. Cremaster muscle. Attachments: external fleshy, internal tendinous; forms loops over the cord, giving rise to cremasteric fascia.

Dissection.—On the left side of the body the student should not make any further dissection of the abdominal wall; but the parts that have been reflected in the groin should be carefully replaced, until he returns to the examination of those parts in connection with hernia. In left groin replace parts.

On the right side divide the cremaster muscle longitudinally, and reflect it from the cord. Afterwards cut through the internal oblique near the ribs, and near the crest of the ilium, and connect those incisions behind: the depth of the muscle will be indicated by a cellular layer between it and the transversalis. Throw the muscle forwards to the edge of the rectus, cutting at the same time the fibres that arise from Poupart's ligament, and separating them with great care from those of the transversalis, with which they are often conjoined. In raising the muscle the branches of the intercostal nerves and arteries will be exposed, and many branches that enter it must be cut: but the student should dissect On right side of abdomen reflect cremaster and internal oblique.

out of it the last dorsal nerve, and the two branches of the lumbar plexus (ilio-hypogastric and ilio-inguinal), near the front of the crest of the ilium.

Parts covered by internal oblique.

The internal oblique conceals the transversalis muscle, and the vessels and nerves between the two. Near Poupart's ligament it lies on the spermatic cord and the fascia transversalis: the rectus muscle is partly concealed by its aponeurosis.

Transversalis muscle.

The TRANSVERSALIS MUSCLE forms the third stratum in the wall of the abdomen; it is attached on all sides except where the spermatic cord lies, and it has both an anterior and a posterior aponeurosis. It *arises* at the pelvis from the outer third of Poupart's ligament, and from the two anterior thirds of the crest of the ilium. At the chest it takes origin by fleshy processes from the under surface of the cartilages of the six lower ribs. And between the chest and pelvis it is connected with the posterior aponeurosis, or the fascia lumborum. Most of the fibres are directed transversely to the aponeurosis in front. But the lower fibres arch downwards above the spot at which the cord leaves the abdomen, and are inserted (by tendon) with the lower fibres of the internal oblique into the crest of the pubes and into the pectineal line for about one inch, the two forming the structure called the conjoined tendon.

Origin from chest, loins, and pelvis.

Fibres end in aponeurosis.

Lowest arch down to pubes.

The aponeurosis passes beneath rectus to linea alba, except inferiorly.

Its *aponeurosis* is widest inferiorly, as in the most external muscle. It is continued to the linea alba beneath the rectus, except midway between the umbilicus and pubes, where it passes in front of that muscle to reach the middle line. Its attachment to the os pubis is nearly the same as that of the aponeurosis of the internal oblique, for it is fixed to the crest of the pubes and to the pectineal line, but beneath the insertion of the oblique muscle. The tendons or aponeuroses of these two muscles are united near their attachment to the bone, and give origin to the conjoined tendon; but whilst that of the oblique extends beyond the crest of the bone only a short way, the aponeurosis of the transversalis reaches an inch along the ilio-pectineal line. At its insertion into the pubes, some of the fibres are gene-

At pelvis joins that of internal oblique in conjoined tendon.

rally spent on the transversalis fascia, and are connected with the deep arch. Fibres to transversalis fascia.

Superficial to the transversalis are the two muscles before examined, and beneath it is the thin fascia transversalis, which separates it from the peritoneum. The attachments to the ribs digitate with like processes of the diaphragm; and the lower border is fleshy in the outer half, but tendinous in the inner half, and is arched over the internal abdominal ring. Occasionally the muscle arises from Poupart's ligament as low down as the internal oblique, with which it is then inseparably united. Connections of transversalis muscle.

The posterior aponeurosis of the transversalis, or the fascia lumborum, is described in the dissection of the back (p. 363.). Posterior aponeurosis.

Dissection. — To bring into view the rectus muscle, make a longitudinal incision through the aponeurosis covering it, and turn to each side its tendinous sheath. A small muscle, the pyramidalis, will be exposed at the same time near the pubes. The dissector should take care of the nerves entering the outer border of the rectus. To expose rectus and pyramidalis.

The RECTUS MUSCLE extends along the front of the abdomen from the pelvis to the chest. The muscle is narrowest inferiorly, and is attached by two tendinous processes, one to the front and the other to the crest of the pubes; and becoming wider towards the thorax, it is *inserted* into the cartilages of the last three true ribs. The fibres of the rectus are interrupted at intervals by irregular tendinous lines (lineæ transversæ), and the muscle is contained in an aponeurotic sheath. Rectus muscle. Attachments to pubes and ribs. Has cross tendons.

Sheath of the rectus. — At the outer border of the upper part of the rectus muscle, the aponeurosis of the internal oblique divides into two pieces, which pass, one before, the other under that muscle, and unite at its inner border, thus forming a sheath for it. Inseparably united with the front of the sheath is the aponeurosis of the external oblique; and joined in a similar manner with its posterior part is the aponeurosis of the transversalis. At the lower part of the muscle, however, or midway between the umbilicus and the pubes, the sheath suddenly ceases posteriorly, in consequence of the aponeuroses of all the lateral muscles being Its sheath, how formed. Its extent.

Deficient inferiorly. placed in front of the rectus. The spot where the sheath disappears will be seen to be marked by a white well-defined margin, when the outer edge of the muscle is raised. Where the sheath is deficient, the rectus is in contact with the fascia transversalis.

Lineæ transversæ are three or more. Situation. The *Lineæ transversæ* are the tendinous bands that cross the surface of the rectus. There are usually three of these intersections at the following spots: one is opposite the umbilicus, another at the ensiform cartilage, and the other midway between those two. If there is a greater number, the additional ones will be below the umbilicus. These bands seldom extend the whole breadth or depth of the muscular fibres.

Linea semilunaris is at edge of rectus. *Linea semilunaris.* — This line has been already seen, through the aponeurosis of the external oblique muscle, to reach from the eighth rib to the outer part of the crest of the pubes. It marks the outer edge of the rectus muscle, and, consequently, the line of the division of the aponeurosis of the internal oblique muscle.

Pyramidalis muscle. Attachment to pubes and linea alba. The PYRAMIDALIS MUSCLE is triangular in form, and is placed in front of the rectus near the pelvis. The muscle *arises* by its base from the front of the os pubis, and is *inserted* by its apex into the linea alba, about midway between the umbilicus and the pubes. This small muscle is often absent. It is contained in an aponeurotic sheath like the rectus.

Nerves in wall of abdomen. NERVES. — In the wall of the abdomen, between the internal oblique and transversalis muscles, are the intercostal nerves, and near the pelvis are the two branches of the lumbar plexus. Some arteries accompany the intercostal nerves, but they will be again referred to with the vessels of the abdominal wall.

Intercostal nerves are between oblique and transversalis. *a.* The *intercostal nerves* (six lower) enter the wall of the abdomen at the anterior part of the intercostal spaces. Placed between the internal oblique and transversalis muscles, the nerves are directed forwards to the edge of the rectus, which they pierce in their course to become cutaneous along the front of the abdomen. About midway be-

tween the spine and the linea alba, the nerves furnish cutaneous branches to the side of the abdomen (lateral cutaneous); and whilst between the abdominal muscles they supply muscular branches, as well as offsets of communication one with another. A greater part of the lower than of the upper nerves is visible, because of the diminished length of the intercostal spaces.

Offsets.

The *last dorsal nerve* is placed below the last rib, but otherwise it has the same connections and distribution as the preceding. As it extends forwards to the rectus it sometimes communicates with the ilio-hypogastric nerve. Its lateral cutaneous branch perforates the two oblique muscles.

Last dorsal nerve.

b. The two *branches of the lumbar plexus* are seen in a part of their course, viz. between the muscles of the wall of the abdomen.

Branches of lumbar plexus.

The *ilio-hypogastric nerve* perforates the posterior part of the transversalis muscle, near the crest of the ilium, and gives off the *iliac* or lateral cutaneous branch. The continuation of the nerve then turns forward near the crest of the ilium, and is connected with the following nerve (ilio-inguinal), near the front of that bone. Perforating now the fleshy part of the internal oblique, and the aponeurosis of the external oblique near the linea alba, the nerve becomes cutaneous as before seen (p. 417.). The *iliac branch* pierces both oblique muscles, near the crest of the ilium, to reach the gluteal region.

Ilio-hypogastric lies near crest of the ilium.

Furnishes cutaneous branch.

The *ilio-inguinal nerve* appears on the surface of the transversalis, near the front of the crest of the ilium, where it is connected with the preceding. The nerve afterwards pierces the internal oblique, to which it supplies branches, and coursing over that muscle, reaches the surface of the thigh through the external abdominal ring (p. 417.).

Ilio-inguinal issues through ring.

This nerve may be so small as to end by joining the ilio-hypogastric branch. In such case the ilio-hypogastric furnishes an offset that takes the usual place and distribution of the ilio-inguinal nerve.

May be very small.

Dissection.—For the purpose of seeing the transversalis fascia it will be necessary to raise the lower part of the muscle of the same name on the right side by two incisions; — one through the fibres that are attached to Poupart's ligament; the other across the muscle from the crest of the ilium to the margin of the rectus. With a little care the muscle will be separated from the thin fascia beneath.

Dissection of transversalis fascia.

Fascia transversalis is best marked in the groin.

The *fascia transversalis*, which has been so named by Sir A. Cooper, is a thin fibrous layer between the transversalis muscle and the peritoneum. In the groin or inguinal region, where it is unsupported by muscles, the fascia is stronger than in any other part of the wall of the abdomen, and is joined by fibres of the aponeurosis of the transversalis muscle. In the part of the fascia now exposed is the opening of the internal abdominal ring, which gives passage to the spermatic cord, or the round ligament. It is situate midway between the symphysis pubis and the anterior superior spine of the ilium, and half an inch above Poupart's ligament. From the margin of the opening a thin tubular prolongation is continued around the cord. The fascia on the inner side of the opening is thinner than on the outer side, and is fixed internally into the os pubis and the pectineal line of that bone, behind the conjoined tendon with which it is united. When traced down to Poupart's ligament, the fascia is found to be connected to the posterior margin of that band along its outer half; but along the inner half of the ligament the fascia passes downwards to the thigh, being but slightly connected with that structure, and forms the anterior part of the femoral sheath. Above the inguinal region the membrane gradually decreases in strength as it ascends beneath the transversalis muscle, until at the thorax it becomes an unimportant cellular structure.

Near Poupart's ligament is the internal abdominal ring.

Is fixed into the pelvis.

Is partly joined to Poupart's ligament, and partly not.

Superiorly it decreases in strength.

Dissection.

Dissection.— Divide the transversalis fascia by a longitudinal incision begun a little above the abdominal ring, and continued downwards through that spot, so as to trace a prolongation of the fascia on the cord. With the handle of the scalpel the fascia may be easily reflected to each side from the subperitoneal fat. After the subperitoneal fat has been seen, let it be removed to trace the remains of the tube of peritoneum along the cord.

Subperitoneal fat in the groin.

The *subperitoneal fat* is placed between the fascia transversalis and the peritoneum. The depth of this layer varies much in different bodies, but the stratum is thicker at the lower part of the abdomen than elsewhere. A prolongation is sent from it along the cord. This structure will be more

specially examined in the dissection of the wall of the abdomen from the inside.

The *peritoneum* is seen to project slightly forwards opposite the cord, on the removal of the subperitoneal fat, and to be joined by a fibrous process, the remains of the prolongation to the testis. There is great variety in the condition of this part. Thus in one case it can be followed only a very short distance, whilst in another it may be traced as a fine band to the tunica vaginalis of the testis. In other instances the tube of the peritoneum has been imperfectly obliterated, and one large pouch or sac is left in front of the cord in the inguinal canal; or the tube has been obliterated only here and there, forming a sacculated piece. Lastly, in some rare cases, the process of peritoneum remains unobliterated, so that a coil of intestine can descend along it from the abdomen. In the female the tube sometimes remains pervious for a short distance (canal of Nuck) in front of the round ligament.

Peritoneum of the groin is prolonged on the cord; piece may be impervious, or sacculated, or open. In female, partly open.

The SPERMATIC CORD extends from the internal abdominal ring to the testis, and consists of the vessels and the efferent duct of that gland united together by coverings from the structures by or through which they pass. In the wall of the abdomen the cord lies obliquely, because its aperture of entrance therein, or the internal abdominal ring, is not opposite its aperture of exit from the muscles, or the external ring; but escaped from the abdomen, it descends almost vertically to its destination. Being placed obliquely between the muscles, the cord lies at first beneath the internal oblique, and rests against the fascia transversalis; but beyond the lower border of the oblique muscle it rests on the upper surface of Poupart's ligament, having the aponeurosis of the external oblique between it and the surface of the body, and the conjoined tendon between it and the abdomen. Its different coverings have been seen in the examination of the parts from which they are derived, there being a prolongation from each structure in the wall of the abdomen, except from the transversalis muscle. Thus, proceeding from within outwards, the student will find the following layers surrounding the constituents of the cord:— first, the sub-

Spermatic cord is oblique in the abdomen and vertical beyond. Connections with parts around. Coverings.

peritoneal fat, then the tube of the fascia transversalis, next the cremaster muscle from the internal oblique, afterwards the intercolumnar fascia from the external oblique muscle, and lastly the superficial fascia and the skin.

In female, round ligament is in place of cord.

The *round ligament*, or the suspensory cord of the uterus, occupies the inguinal canal in the female. Its coverings are the same as those of the spermatic cord, except it wants, usually, the cremaster. It ends in the integuments of the groin.

Dissection.

Dissection.—The constituents of the cord will be exposed by turning aside the different surrounding layers and removing the cellular membrane. The dissector should trace branches of the genito-crural nerve and epigastric artery into the cremasteric covering.

Constituents of the cord.

Vessels and nerves of the cord.—In the cord are collected together the spermatic artery and veins that convey the blood to and take it away from the testis, nerves and lymphatics of the testicle, and the vas deferens or the efferent duct.

Spermatic artery,

The *spermatic artery* is a branch of the aorta, which enters the cord through the internal abdominal ring, and descends to the testis, in which it ends. It distributes branches to the vas deferens and the epididymis. In the female, a branch from the *ovarian* artery (spermatic) enters the round ligament. The *spermatic veins* leave the posterior part of the testicle, and receive branches from the epididymis: ascending in the cord, in front of the vas deferens, they divide and anastomose, forming the *spermatic plexus*. The *nerves* are derived from the spermatic plexus of the sympathetic in the abdomen; they accompany the artery to the testicle. The *lymphatics* begin in the testis, and ascend along the cord through the internal abdominal ring to join the lumbar glands. The *vas deferens* is placed behind the other constituents of the cord, and will be easily recognised by its resemblance to a piece of whipcord when it is taken between the finger and the thumb. As it enters the abdomen through the opening in the fascia transversalis (internal ring), it lies on the inner side of the vessels of the cord, and

veins, nerves. Lymphatics. Vas deferens. Situation and course.

it winds behind the epigastric artery in its descent to the urethra in the pelvis.

The cremasteric covering of the cord has a separate artery and nerve. The *artery* is derived from the epigastric (its cremasteric branch), and is distributed to the coverings of the cord. The *genital branch* of the genito-crural nerve enters the cord by the internal abdominal ring, and ends in the cremaster muscle. Other filaments to the cord come from the ilio-inguinal nerve. Artery and nerve of the coverings of the cord.

Dissection.—Cut across the cord near the abdominal ring, and turn it upwards on the abdomen. Below Poupart's ligament will be sometimes seen a thin band (deep crural arch) passing inwards to the os pubis. The dissector should define this band with care. Afterwards the remaining vessels of the abdominal wall should be exposed, viz. the epigastric and circumflex iliac, and the ending of the internal mammary artery. On turning up the outer edge of the rectus, the epigastric and mammary arteries will be seen, one above and the other below; and the epigastric with its branches may be further traced by removing the fascia transversalis that covers it near Poupart's ligament. The circumflex iliac artery may be observed behind Poupart's ligament (the outer half), and should be pursued along the crest of the ilium. Dissection of deep arch and of the vessels.

Deep crural arch.—Below the level of Poupart's ligament is the thin band of fibres which lies over the femoral vessels, and has received the name of deep arch.* This fasciculus of fibres begins externally about the centre of Poupart's ligament, and is prolonged inwards to the pubes, where it becomes wider, after the fashion of Poupart's ligament, and is inserted into the pectineal line on the abdominal aspect of Gimbernat's ligament. This structure is closely connected with the front of the femoral sheath, and is arched down on the inner side to be fixed to the bone. Deep crural arch.

Vessels in the Wall of the Abdomen.—With the intercostal nerves on the side of the abdomen are the intercostal and lumbar arteries; and in the sheath of the rectus, the epigastric and internal mammary vessels. Around the crest of the ilium is the circumflex iliac branch. Vessels in abdominal wall.

* In six bodies, both male and female, that I examined carefully, I found this band to be formed only by a thickening of the fascia transversalis.

Intercostal arteries.

The *intercostal arteries* enter the abdominal wall between the transversalis and internal oblique muscles, at the anterior part of the intercostal spaces. As they extend forwards with the nerves they supply the contiguous muscles, and anastomose with the internal mammary, epigastric, and lumbar arteries.

The vessel that accompanies the last dorsal nerve is furnished by the first lumbar artery.

Internal mammary.

The *abdominal branch of the internal mammary artery* (p. 231.) enters the wall of the abdomen beneath the cartilage of the seventh rib. Descending for a short distance in the sheath of the rectus, the artery enters the substance of that muscle, and anastomoses in it with the epigastric artery.

Epigastric artery anastomoses with internal mammary in sheath of rectus. Connections in wall of abdomen.

The *epigastric artery* arises from the external iliac about a quarter of an inch above Poupart's ligament; and ascending in the sheath of the rectus, it divides above the umbilicus into branches that enter the muscular substance, and anastomose with the internal mammary. In its course the vessel is first bent inwards, but it then ascends beneath the fascia transversalis, and perforating that fascia, enters the sheath of the rectus over the defined border at the posterior aspect. As it ascends to the sheath of the rectus the artery passes beneath the cord and on the inner side of the internal abdominal ring; and is directed obliquely inwards across the lower part of the abdomen, where it forms the lateral boundary of a triangular space between it and the edge of the rectus muscle.

Branches.

The *branches* of the artery are numerous but inconsiderable in size.

Pubic

a. The *pubic branch* is a small transverse artery that runs behind Poupart's ligament to the posterior aspect of the pubes, where it anastomoses with a similar branch from the opposite side.

joins obturator by an offset

Behind the pubes it gives downwards a branch to communicate with a small offset from the obturator artery: the size of this last offset varies very much but its situation is internal to the crural ring.

Cremasteric.

b. A *cremasteric* or spermatic branch is furnished to the coverings of the cord as before mentioned.

Muscular.

c. *Abdominal branches* are given from the outer side of the artery to supply the muscles of the abdominal wall, and to anastomose with the intercostal arteries. Other branches enter the rectus.

Cutaneous.

d. Some *cutaneous offsets* pierce the rectus, and ramify in the integument with the cutaneous nerves.

Epigastric veins.

Two *veins* are found with the epigastric artery, but these join into one before they open into the external iliac vein.

Peculiarities in origin.

Peculiarities. — The position of this artery on the trunk of the external iliac may be shifted from the level of Poupart's ligament to two

inches and a half above; or the origin of the vessel may be transferred to the superficial or the deep femoral artery. Frequently the epigastric furnishes the obturator artery to the pelvis; in such case the small communicating offset, which is ordinarily given to the obturator, may be supposed to be enlarged.

May give off obturator.

The *circumflex iliac artery* arises from the outer side of the external iliac opposite the epigastric, and then courses outwards around the crest of the ilium, as the name expresses. At first the artery is below Poupart's ligament, after it has pierced the tube of membrane that surrounds the upper part of the femoral vessels, but it next passes beneath the transversalis muscle to the middle of the crest of the ilium. Here the vessel pierces the transversalis, and is continued backwards between it and the internal oblique to anastomose with the ilio-lumbar branch of the internal iliac artery. Its *branches* are muscular and anastomotic.

Circumflex iliac is in wall of abdomen, and anastomoses with ilio-lumbar.

Near the front of the crest of the ilium a small branch ascends between the internal oblique and transversalis muscles, supplying them, and anastomosing with the epigastric and lumbar arteries. As the vessel extends backwards it gives lateral offsets that supply the neighbouring muscles, and communicate on the one side with the ilio-lumbar, and on the other with the gluteal artery.

Muscular offsets.

The companion *vein* with this artery is formed by the junction of two collateral branches, like the epigastric, and crosses the external iliac artery, nearly an inch above Poupart's ligament, to reach the vein on the inner side.

Circumflex vein.

Section II.

HERNIA OF THE ABDOMEN.

The lower part of the wall of the abdomen, that has been reserved on the left side of the body, should now be dissected for the anatomy of inguinal hernia.

Inguinal hernia.

Dissection.—The skin, the superficial fascia, and the aponeurosis of the external oblique having been already reflected in the previous examination of the wall of the abdomen, the necessary dissection of the inguinal region will be completed by raising the internal oblique muscle. Make one incision across the fleshy part of the internal oblique, from the crest of the ilium towards the linea alba; and after the depth of the muscle is ascertained by the cellular layer beneath, cut carefully through the origin of the lowest fibres from Poupart's ligament; then detaching it cautiously from

The necessary dissection to be made on the left groin.

the subjacent transversalis, turn it upwards on the abdomen. The separation of the two muscles just mentioned is sometimes difficult in consequence of their fibres being blended together, but a cellular interval and a branch of the circumflex iliac artery mark their intermuscular space. Afterwards divide the cremaster muscle or fascia on the cord, and turn it to the side. Let the dissector clean the surface of the transversalis muscle without displacing its lower arched border, and trace with care the conjoined tendon of the internal oblique and transversalis, to show its exact extent outwards. The fascia transversalis and the spermatic cord should likewise be nicely cleaned. Crossing the space below the border of the transversalis muscle is the epigastric artery, which lies close to the inner side of the internal abdominal ring, but beneath the fascia transversalis. A small piece of the fascia should be cut out to show that vessel on the side of the abdominal ring.

Situation of inguinal hernia.

Inguinal hernia. — The previous dissection has sufficed to show that the weakest part of the abdominal wall is just above Poupart's ligament, where the two internal muscles are wanting, and arch over the spermatic cord. In consequence of this deficiency in the muscular strata, the intestine escapes most readily at this part of the abdomen, and gives rise to an inguinal hernia. But the intestinal protrusion in the inguinal region is predisposed to by the passage of the spermatic cord through the abdominal parietes, and by the existence of fossæ on the inner surface of the wall. The gut, in leaving the abdomen, either passes through the internal abdominal ring with the cord; or it may be projected through the part of the abdominal wall between the epigastric artery and the edge of the rectus muscle, which corresponds to the fossæ before alluded to. The hernia of this region is distinguished by names derived from its position with respect to the epigastric artery (external or internal), or from its direction in the abdominal wall (oblique or direct); so that the hernia that comes through the internal abdominal ring with the cord is called synonymously external or oblique, whilst the hernia between the edge of the rectus and the epigastric artery is named, in like manner, internal or direct.

Predisposition naturally.

Course it follows.

Two kinds. External or oblique; internal or direct.

External or oblique.

External or oblique inguinal hernia leaves the abdomen with the spermatic cord, and after traversing the in-

guinal canal, makes its exit from the wall of the abdomen by the external abdominal ring.

Anatomy. — To acquire a knowledge of this hernia it will be necessary to study the space in which it lies (inguinal canal), the apertures by which it enters and leaves the wall of the abdomen (abdominal rings), and the coverings that it receives in its progress to the surface of the body. Anatomy of parts concerned.

The *inguinal canal* is the interval between the flat muscles of the abdominal wall, which contains the spermatic cord of the male, or the round ligament of the female. Its direction is oblique downwards and inwards, being nearly parallel to Poupart's ligament; and its length is about one inch and a half. Superiorly it communicates with the cavity of the abdomen by the internal abdominal ring, and inferiorly ends on the surface by the external abdominal ring. Towards the surface of the body the canal is bounded by the two oblique muscles: — the outer third of its extent (half an inch) being formed by the fleshy internal oblique, together with the aponeurotic part of the external oblique; and the inner or lower two-thirds (one inch) being completed by the aponeurosis of the external oblique alone. Next the cavity of the abdomen the wall of the canal is formed by the fascia transversalis, and by the conjoined tendon of the internal oblique and transversalis, in this wise: — the fascia alone reaches about half an inch of the distance, like the internal oblique; and the conjoined tendon, with the fascia transversalis behind it, extends the rest of the way (an inch) along the posterior boundary. Occasionally the triangular ligament projects far enough outwards to take part in the formation of the posterior wall of the canal behind the external abdominal ring. Along the lower part, or the floor, the canal is limited by the union of the fascia transversalis with Poupart's ligament, and by the fibres of that ligament that turn back to the pectineal line; whilst along the upper part its extent is determined only by the apposition of the muscles. Inguinal canal. Direction. Length. Openings. Boundaries next surface. Next the abdominal cavity. Flooring and roof of the canal.

In the female, the canal has the same length and boundaries, though it is usually somewhat smaller. In that sex it lodges the round ligament. Canal in the female.

The *internal abdominal ring* is an aperture in the fascia Internal

Abdominal ring. Situation. Form and margin. Upper and inner boundary. Parts transmitted through it.

transversalis, which is situate half way between the symphysis pubis and the crest of the ilium, and half an inch above Poupart's ligament. It is oval in form, the extremities of the oval being directed upwards and downwards, and the fascia at its outer and lower parts is stronger than at the opposite margin. Arching above the aperture, and then descending on the inner side, is the lower border of the transversalis muscle, which is fleshy in its outer, but tendinous in its inner half. On the inner side of the opening lies the epigastric artery. This opening in the fascia transversalis is the inlet to the inguinal canal, and through it the cord, or the round ligament, passes into the wall of the abdomen. The external hernia likewise leaves the abdomen at the same spot. All the protruding parts receive as a covering a prolongation of the fascia from the margin of the opening.

External abdominal ring. Situation.

The *external abdominal ring* is the outlet of the canal, and through it the cord, or the inguinal hernia, reaches the surface of the body. This aperture is placed in the aponeurosis of the external oblique muscle, near the crest of the ilium, and from its margin a prolongation is sent on the parts passing through it (see p. 421.).

The intestine, following the course of the cord. Its coverings of the peritoneum and fat, fascia transversalis, cremaster, spermatic fascia, superficial fascia.

Course and coverings of the hernia. — When a piece of intestine leaves the abdomen with the cord, and continues with it to the surface of the body, it will obtain the same coverings, viz. one from every structure in the wall of the abdomen, except the transversalis muscle. It receives its investments in this order: — as the intestine is first thrust outwards, it carries before it the peritoneum and the subperitoneal fat, and enters the tube of the fascia transversalis (infundibuliform fascia) that surrounds the cord. Still increasing in size the piece of gut is directed downwards to the lower border of the internal oblique muscle, where it has the cremasteric fascia or covering applied to it. The intestine is afterwards directed along the front of the cord to the external abdominal ring, and in passing through that opening receives the investment of the intercolumnar or spermatic fascia. Lastly, as the hernia descends to the scrotum, it has the additional coverings of the superficial

fascia and the skin. So that in a hernia which has passed the external abdominal ring, the coverings from without inwards are the following: the skin and superficial fascia, the spermatic and cremasteric fasciæ, the fascia transversalis, the subperitoneal fat, and the peritoneum or sac: these different laminæ become much thickened in a hernia that has existed for some time. Should a piece of intestine remain in the inguinal canal (bubonocele), the layers that invest it will depend upon the spot to which it has extended. cia, and skin, if it has left the abdominal wall.

Seat of stricture. — The protruded intestine may be constricted in the internal abdominal ring by the neck of the sac, in the inguinal canal by the fleshy internal oblique muscle, or at the external abdominal ring; and the frequency of the seat of stricture is the same as the order in which the constricting parts are here mentioned. Whilst efforts are being made to force back the piece of protruded intestine, the direction of the canal and the situation of the internal abdominal ring should be borne in mind; and should it be necessary to expose the intestine and divide the strictured part from within, the incision should be made directly upwards. Stricture where situate. To free it, direction of the incision.

It may here be remarked that this kind of hernia has other names applied to it by surgeons; these designations depending on its having passed certain points in the wall of the abdomen, or upon the condition of the sac of the peritoneum. If the protrusion remains in the inguinal canal, the term bubonocele is applied to the swelling; but if it has extended into the scrotum, the appellation of scrotal rupture, or oschecocele, is given to it. Should the piece of peritoneum that accompanies the testicle from the abdomen in the fetus remain unobliterated, and the intestine descend in it, the hernia is called congenital; but should that prolongation of the peritoneum be partly obliterated, say in the inguinal canal, so that the descending intestine projects into the unobliterated part from above or behind, like a viscus into a serous membrane, the hernia is named infantile. Terms applied to the inguinal hernia from its position and from the nature of the peritoneal sac.

The INTERNAL OR DIRECT INGUINAL HERNIA passes through the wall of the abdomen internal to the epigastric artery, Internal hernia

comes behind external ring. and has a straight course through the abdominal parietes and the external abdominal ring. Its situation and its coverings will be comprehended after the examination of the part of the abdominal wall through which the hernia passes.

It passes through a triangular space, which is strengthened in part by conjoined tendon. *Anatomy.*— At the lower part of the abdominal wall is a small triangular space between the epigastric artery on one side, the outer edge of the rectus muscle on the other, and the inner part of Poupart's ligament below. Over the two inner thirds of the area of the space the conjoined tendon of the internal oblique and transversalis is stretched, as it descends to its insertion into the pectineal line; but in the outer third there exists only fascia transversalis. Any intestine protruding in this spot must, it is evident, rupture or elongate the different structures, because there is not any aperture or tube by which it can descend, as in the external hernia; and, further, the coverings of the hernia, and its extent and direction in the lower part of the inguinal canal, must vary according as the gut is forced through the part of the space covered by the conjoined tendon, or through the part free from that tendon.

Hernia in this space of two kinds.

Coverings of the more common kind are *Coverings of the hernia.*—The more common kind of internal hernia (inferior) passes through that part of the triangular space which is covered by the conjoined tendon; and this kind is found to be present when the obliterated hypogastric artery takes its usual course along the interior of the abdominal wall, behind or near to the epigastric artery. The intestine in protruding carries before it the peritoneum, the subperitoneal cellular membrane, and the fascia transversalis; next, it either elongates the conjoined tendon, or, as is the case in a sudden rupture, separates the fibres, and escapes between them. Now the intestine has advanced into the lower part of the inguinal canal, where it is opposite the external abdominal ring; and it passes outwards through the ring, lying on the inner side of the cord, and receiving at the same time the covering of the fascia spermatica. Lastly, it is invested by the superficial fascia and the skin. In number the coverings of this internal hernia are the same as in the external form; and in kind

peritoneum and subjacent fat, fascia transversalis conjoined tendon, spermatic fascia, superficial fascia, and skin.

they are the same, with this exception, viz. that the conjoined tendon is substituted for the cremasteric covering.

Seat of stricture.—The stricture in this form of hernia is found most frequently at the neck of the sac, next in frequency at the margin of the fissured tendon, and lastly at the external abdominal ring. The position of the openings in the abdominal wall should be kept in mind during attempts to reduce an internal hernia; and the straightness of the course of the intestine, when compared with an external hernia, should be remembered. Where it is necessary to open the hernial sac to relieve the structure, the cut should be made directly upwards, as in the external hernia.

Stricture. Situation.

Its division.

Rarer kind of internal hernia.—Another kind of internal hernia (superior) projects through that part of the triangular space in which the abdominal parietes is formed only by fascia transversalis. Its existence is generally owing to an unusual position of the obliterated hypogastric artery,—that cord crossing the triangular space, where the two inner thirds join the outer third, instead of lying behind the epigastric artery, and thus predisposing to a hernial protrusion by reason of the fossa that it produces in the interior of the abdomen. The student will perceive that if a hernia exists at the part specified, it would be close to the epigastric artery, that it would descend along nearly the whole of the inguinal canal to reach the external abdominal ring, and that consequently the term direct would not apply to this form of internal hernia.

Rarer kind of internal hernia

is farther out than the preceding in the triangular space,

and is oblique in direction.

Coverings.—As this form of internal hernia traverses nearly the whole of the inguinal canal, it has exactly the same number and kind of coverings as the external hernia that accompanies the spermatic cord, viz. the skin and the superficial fascia, the spermatic and cremasteric fasciæ, the fascia transversalis, and the subperitoneal fat and the peritoneum.

Coverings are same as in external hernia.

Seat of stricture.—The constriction of the intestine will be at the same spots as in the external hernia; and from the impossibility of deciding in the living body whether the form of hernia now under consideration is internal or external, the rule observed in dividing the stricture is to make the in-

Stricture at same spots.

Division of it.

cision directly upwards, as in the other kinds of inguinal hernia.

Umbilical hernia. UMBILICAL HERNIA, or exomphalos, is a protrusion of a piece of intestine either through or by the side of the umbilicus. It is very variable in size, and its course is straight through the abdominal wall.

Coverings *Coverings.*—The coverings of the intestine in a small hernia are thin and few in number, viz. the skin and the superficial fascia, a prolongation from the tendinous margin of the abdominal opening, together with the remaining common coverings of the fascia transversalis, the subperitoneal fat, and the peritoneum. Over the end of the tumour the fat of the superficial fascia disappears, and this covering becomes blended with the other structures on each side of it. If the hernia is suddenly produced, it may want the investment that otherwise is derived from the tendon of the external oblique muscle.

become united over the tumour.

Stricture, where found. *Seat of stricture.*—The stricture on the intestine is generally found at the margin of the tendinous opening in the abdominal wall; and it should be remembered that this opening is at the upper part, not in the centre of the swelling. The constriction may be removed by cutting upwards, but there is not any vessel to be avoided in the operation.

Other abdominal herniæ are femoral, obturator, ischiadic. OTHER FORMS OF HERNIA.—At each of the other natural apertures in the parts bounding the cavity of the abdomen, a piece of intestine may be protruded, so as to form a hernial tumour. For instance, there may be *femoral hernia* below Poupart's ligament, with the femoral vessels; *obturator hernia* through the obturator foramen, with the artery of the same name; and *ischiadic hernia* through the ischiadic notch. The femoral hernia, as the most important, will be noticed presently; but the student must refer to some special treatise for his information respecting the other abdominal herniæ.

Dissection. *Dissection.*— The abdomen may now be opened to see the cords and the depressions on the posterior aspect of the abdominal wall, below the umbilicus. For this purpose make a transverse cut through the umbilicus across the front of the abdomen, and on

holding up the lower flap certain cords will be seen ascending to the umbilicus.

Cords and fossæ of the abdominal wall.—In the middle line of the abdominal wall, at its posterior aspect, is the prominence of the remains of the urachus, which reaches from the summit of the bladder to the umbilicus. On each side is another cord, or the projection of the obliterated hypogastric artery, which is directed from the side of the pelvis to the umbilicus, and usually lies behind or close to the epigastric artery, near Poupart's ligament. When the disposition of the cords is such as above mentioned, two fossæ are seen near Poupart's ligament, one on each side of the obliterated hypogastric artery, corresponding to the situation of the internal and external abdominal rings. But sometimes the cord of the obliterated hypogastric is removed inwards from the line of the epigastric artery, and crosses the triangular space between this artery and the edge of the rectus, in the line of union of the outer with the two inner thirds. In this last case there are three fossæ at the lower part of the abdomen;—one on each side of the obliterated hypogastric, corresponding to the two subdivisions of the triangular space between the rectus and the epigastric artery, and to the spots at which the two kinds of internal hernia escape; and the third fossa is outside the epigastric artery, opposite the internal abdominal ring. The existence of these fossæ determines the different kinds of inguinal hernia.

Cords and fossæ inside abdomen; one in middle line, another on each side, forming two fossæ.

Sometimes last cord moved inwards causing three fossæ.

Number of the hernial protrusions same as fossæ.

FEMORAL HERNIA.—In this hernia the intestine leaves the abdomen below Poupart's ligament in the sheath that surrounds the femoral vessels. The course that the intestine takes, and the coverings that it receives, will be easily understood after the anatomy of the parts among which it passes has been learnt. Only part of the anatomy will be given here, because the rest is fully described in the dissection of the thigh.

Situation of the femoral hernia.

Dissection.—Divide the lower part of the abdominal wall by an incision from the umbilicus to the pubes; and on the left side of the body proceed to examine the structures concerned in the formation of femoral hernia. Detach the peritoneum from the inner

Dissection of the parts concerned.

surface of the abdominal wall and from the iliac fossa. Next separate in the same way the layer of the subperitoneal fat, but before doing this it will be necessary to cut through the cord at the abdominal ring: as this layer is raised, one or more lymphatic glands will be seen by the side of the iliac vessels. Any cellular membrane that remains is to be taken away to show the upper opening of the membranous sheath that contains the femoral vessels. In this dissection the genito-crural nerve is seen on the iliac artery. Afterwards trace the iliac fascia and the fascia transversalis to Poupart's ligament, to see the part that each takes in the production of the femoral sheath.

Anatomy of the structures.

Anatomy.— The structures concerned in the production of the femoral hernia are severally to be examined, viz. the subperitoneal fat, the membranes lining the interior of the abdominal cavity near Poupart's ligament (transversalis and iliac fascia), with the sheath to which they give origin; and, lastly, the crural ring, or the space through which the hernia leaves the abdomen.

Subperitoneal fat

forms septum crurale.

The *subperitoneal fat* extends as a continuous layer beneath the peritoneum, though it is thickest and most fibrous at the lower part of the abdomen, where the vessels pass beneath Poupart's ligament. Here it extends over the upper opening of the sheath of the vessels, instead of descending in it around the vessels. Internal to the vein it covers the space of the crural ring, and a lymphatic gland that occupies that space. The piece of the layer that stretches over the crural ring is named by M. Cloquet *septum crurale*, and is described by him as being concave towards the abdomen, and convex towards the thigh. Some apertures exist in it for the ducts of the inguinal glands, and one gland is generally attached to its under surface.

Fascia transversalis.

The *fascia transversalis* has been before described (p. 430.). When traced down to Poupart's ligament, it is seen to join the iliac fascia external to the situation of the large iliac artery; but internal to that spot it is continued downwards in the thigh, in front of the femoral vessels, and forms the anterior part of the femoral sheath.

Iliac fascia.

The *iliac fascia* covers the iliacus muscle, and lies beneath the iliac vessels. When it is followed down to Poupart's ligament its disposition is found to resemble that of the

transversalis fascia; for external to the iliac vessels it joins that fascia along the line of Poupart's ligament; but, internal to the spot mentioned. it is prolonged behind the vessels into the posterior part of the femoral sheath.

> Sheath of femoral vessels formed by offsets of preceding.

The *femoral sheath*, or the loose membrane that encloses the femoral vessels as they enter the thigh, is derived from the membranes that line the abdomen; — its anterior part being continuous with the fascia transversalis, and its posterior part with the fascia iliaca. The whole of the upper part of the sheath is not filled by the vessels, but a space remains on the inner side of the vein (crural ring) which contains a gland, and through which the intestine descends in femoral hernia.

> A space on inner side of the vessels is the crural ring.
>
> Size and boundaries.

The *crural ring* is described in the dissection of the thigh, but its boundaries are better seen here. This space on the inner side of the femoral vein is about half an inch wide, and is filled by a lymphatic gland. Internally, it is bounded by Gimbernat's ligament and the conjoined tendon, and externally by the femoral vein. In front is Poupart's ligament with the deep arch, and behind is the pubes. Along the front of the space is the spermatic cord in the male, and the round ligament in the female.

> Usual vessels around ring.

Position of vessels around the ring.—Usually the crural ring is partly surrounded by vessels. Thus, on the outer side, is the femoral vein; above, and on the outer side, are the epigastric vessels; and in front is a small branch (pubic) from the epigastric artery to the back of the pubes. Moreover, the vessels of the spermatic cord may be said to be placed along the front of the ring. Commonly, therefore, the ring is bounded by vessels, except internally and behind.

> State of the unusual vessels.

But in some instances the obturator artery takes origin from the epigastric, and passes to the pelvis, either close to the iliac vein, and therefore on the outer side of the ring, or it arches over the ring, descending on its inner side at the base of Gimbernat's ligament. If the artery takes the first-mentioned course, which is the most frequent arrangement, the extent of vessels around the ring is not increased, for the vein previously occupied this same side. But in the other case the ring will have an additional vessel on the

inner side, and will be entirely encircled except at the posterior part.

Course and coverings of the hernia.

Coverings of femoral hernia.— The intestine, as before said, leaves the abdomen by the opening of the crural ring; and it descends in the large sheath of the vessels, internal to the vein, as far as the saphenous opening, where it projects to the surface of the thigh. In its progress the intestine will push before it the peritoneum, the subperitoneal fat, (septum crurale), and will displace, or cause to be absorbed, the gland that fills the crural ring. Having reached the level of the saphenous opening, the intestine carries before it the inner side of the femoral sheath and the cribriform fascia; and, lastly, it receives coverings from the superficial parts of the thigh. The dissection of the thigh may be referred to for fuller detail.

From abdomen it has peritoneum and subperitoneal fat.

Inner part of sheath.

Stricture

Seat of stricture. — The stricture of a femoral hernia is either in the neck of the sac, opposite the base of Gimbernat's ligament, or lower down, at the margin of the saphenous opening. To free the intestine from the constricting band of the upper part of the saphenous opening, an incision is to be made upwards and inwards; and to relieve the stricture in the neck of the sac, the knife is to be carried horizontally inwards through a few fibres of the free edge of Gimbernat's ligament. In the use of the knife there is danger of wounding some of the many vessels that lie about the ring. When the incision is made inwards, or upwards and inwards (the only two ways, it is to be remembered, by which the constricting bands can be loosened), there is not, in ordinary cases, any vessel that will be injured, unless, indeed, the cut upwards and inwards should be made so long as to reach the spermatic cord, or the small pubic branch of the epigastric artery. But in some few instances (once in about eighty operations, Lawrence) the obturator artery lies in front and on the inner side of the neck of the sac, and will be before the knife in whichever of the two available directions it is used; the existence of this condition of the vessel cannot be recognised beforehand, and the surgeon will best avoid the danger of wounding the artery by a cautious and sparing use of the knife.

either in neck, or at saphenous opening.

Incision to divide it.

Risk of wounding vessels in regular

and irregular condition of them.

SECTION III.

CAVITY OF THE ABDOMEN.

Dissection.—THE part of the abdominal wall above the umbilicus is to be divided by a cut along the left side of the linea alba as far as the xiphoid cartilage. When the flaps are thrown to the sides, the cavity of the abdomen is exposed.

Dissection to open abdomen.

The ABDOMEN is the largest cavity in the body, and lodges the digestive, the urinary, and the generative organs. It is oval in form, and the greatest measurement is from above downwards. Superiorly it is limited by the diaphragm; and inferiorly by the pelvis, and by the structures that close the outlet of the pelvis. In front and on the sides are the abdominal muscles; and behind is the spinal column, with the psoas and quadratus muscles. The space included by the boundaries above mentioned is wider above than below, and is divided for anatomical purposes into the cavity of the abdomen and the cavity of the pelvis.

Cavity of abdomen. Form and boundaries. Is divided into

The *cavity of the pelvis* contains some of the generative and urinary organs: it will be examined further on.

Cavity of pelvis

The *cavity of the abdomen* extends from the diaphragm to the brim of the pelvis. In it are contained the kidney; with the alimentary tube, and its appendages the liver, pancreas, and spleen. The space is lined by a serous membrane (peritoneum), which is reflected around the viscera.

and of abdomen proper.

Regions.—The abdominal cavity is divided artificially into regions by lines extended from certain points of the wall. If two circular lines are carried round the body—one opposite the cartilage of the ninth rib, and the other on a level with the most prominent part of the crest of the ilium—the cavity of the abdomen will be divided into three parts, the epigastric above, the hypogastric below, and the umbilical in the middle. Each of these regions is further subdivided by another line, on each side, from the cartilage of the ninth rib to the anterior superior spine of the innominate bone. This vertical line marks off a piece from each of the three circles, which is named respectively hypochon-

Abdominal cavity is marked out into regions

driac, lumbar, and iliac (right and left) which lie in that order from above downwards. The central and lower part of the hypogastric subdivision is named pubic region, and each lateral part the inguinal region.

Parts of viscera seen without displacement.

Parts first seen. — On first opening the abdomen the following is the disposition of the parts that come into view: —On the right side is the liver, which is partly concealed by the ribs. On the left side a part of the stomach is visible; but this viscus is chiefly beneath the ribs, and is somewhat overlayed by the liver. Descending from the stomach is the large omentum (a fold of peritoneum), which reaches to the pelvis, and conceals the intestine. If the bladder is distended, a small part of it may come into view just above the pelvis. In some bodies the omentum is raised into the left hypochondriac region, and leaves the small intestine uncovered.

CONNECTIONS OF THE VISCERA.

Connections of viscera to be seen.

The connections of the viscera with the surrounding parts, and their situation in the different regions of the abdomen, may be next examined before the natural position is disturbed.

Position of stomach.

The stomach. — The stomach intervenes between the gullet and the small intestine, and is retained in position by folds of the serous membrane. It is somewhat of a conical form, with the larger end to the left side; and it occupies the left hypochondriac, the epigastric, and part of the right hypochondriac region. The connections with the surrounding parts will depend upon the condition of the stomach: for when this viscus is empty, its surfaces look forwards and backwards, and its borders upwards and downwards; but when it is distended it becomes somewhat circular, and rolls so as to bring forwards the border usually lowest, and to turn upwards that aspect which is directed forwards at other times.

Connections depend on its condition.

Extremities are, large

The left or large end is beneath the ribs, and is in contact with the spleen, which is connected with it by a fold of peritoneum (splenic omentum): when this part of the

stomach is distended it pushes up the diaphragm, and encroaches on the space for the left lung. The right end reaches towards the gall bladder, and is in contact with the wall of the abdomen and with the under surface of the liver. and small.

The anterior surface is in contact with the diaphragm towards the left, with the abdominal wall in the centre, and with the under part of the liver towards the right side; and the posterior surface corresponds to the pancreas, the pillars of the diaphragm, and the solar plexus. Surfaces.

The upper border is connected to the liver by a fold of peritoneum (small omentum); and the lower border has connected with it another fold of the peritoneum (great omentum or epiploon), which floats freely over the intestines. Borders.

The position and the connections of the stomach may be changed by an alteration in the size of any of the surrounding organs, or by accumulations of fluid in the chest or in the belly. The stomach may also be dragged down by the great omentum entering a hernial sac, or it may be forced down towards the pelvis by the pressure of tight stays. In these instances the right end moves more than the left, because it is attached only by peritoneum to the parts around. Alterations in position from disease.

The small intestine. — The smaller part of the intestinal tube (intestinum tenue) reaches from the stomach to the right iliac region, where it ends in the large intestine. It is divided into three parts, duodenum (twelve inch intestine), jejunum, and ileum; of the two last, one receives its name from its empty condition, and the other from its numerous coils. Small intestine. Situation and divisions.

The *duodenum* cannot be satisfactorily seen now, and it will therefore be examined afterwards. Duodenum.

The *jejunum* and *ileum* begin on the left side of the second lumbar vertebra, without any distinct mark of separation from the duodenum. Two-fifths of the intestine are given to the jejunum, and the remaining three-fifths to the ileum. This part of the intestinal tube forms many circumvolutions in the umbilical, hypogastric, lumbar, and iliac regions of the abdomen; and it descends oftentimes in the female into the cavity of the pelvis. In front of the in- Jejunum and ileum. Situation.

Connections. testine is the great omentum; and posteriorly the small intestine (beyond the duodenum) is fixed to the spine by a fold of peritoneum (the mesentery) which includes vessels and nerves. Surrounding the jejunum and ileum is the large intestine or colon, but on the left side of the body the large is concealed by the small intestine.

Large intestine how distinguished. *The large intestine.*—The large intestine or colon is sacculated, and is less movable than the small intestine. It begins in the right iliac region in a dilated part or head (caput cæcum coli), and ascends to the liver through the Course right iliac, lumbar, and hypochondriac regions. Then crossing the abdomen below the stomach, it reaches the left hypochondriac region, and lies in this transverse part of its course between the epigastric and umbilical regions, or altogether and extent. in the latter. Finally, it descends through the regions on the left side, corresponding to those it occupied on the right, forms a remarkable bend (sigmoid flexure) in the left iliac fossa, and ends opposite the brim of the pelvis in the rectum. The large intestine takes an arched course around Divisions. the small intestine, and is divided into six parts, viz. cæcum, ascending colon, transverse colon, descending colon, sigmoid flexure, and rectum.

Cæcum, or head of colon. The *cæcum*, or the commencement of the colon, is placed in the right iliac fossa, in which it is fixed by peritoneum Situation stretched over it. In front are the convolutions of the small intestine, but when it is distended it touches the abdominal and connections. wall. Behind, it rests on the iliac fascia, only cellular membrane intervening. On the inner part it is joined by the small intestine, and it presents inferiorly a worm-like piece—the vermiform appendix. Sometimes the peritoneum surrounds the cæcum, so as to allow of some degree of movement.

Ascending colon. The *ascending colon* reaches from the cæcum to the under surface of the liver, on the right of the gall bladder. It lies against the quadratus lumborum inferiorly, but higher up it Parts around. is placed in front of the kidney. The peritoneum fixes it immoveably to the wall of the abdomen, but this membrane does not surround more than two-thirds of its circumference. To its inner side are the convolutions of the small intestine.

The *transverse colon* passes obliquely upwards and to the left, along the curvature of the stomach, to the spleen. In this extent it has above it the liver and the gall bladder, the stomach, and the spleen; and below it the small intestine. In front is the great omentum; and behind is a fold of peritoneum (transverse meso-colon), which attaches it to the posterior part of the abdominal wall, and contains its vessels and nerves. The transverse colon is more moveable than any other part of the intestinal tube, its peritoneal folds allowing it to be raised and placed on the margin of the ribs. Small pieces of peritoneum, containing fat (appendices epiploicæ), are attached to the intestine.

Connections of the transverse colon: is most moveable piece of large intestine.

The *descending colon* commences below the spleen, and reaches to the left iliac fossa. At first it is deeply placed in the left hypochondriac region, and in its whole course it is deeper than the right colon. In front of it are the convolutions of the small intestine; and behind are the diaphragm, the outer part of the kidney, and the quadratus lumborum. This part of the intestine is smaller than either the right or the transverse portion, and is surrounded less by the peritoneum that attaches it to the abdominal wall.

Descending colon. Situation. Is covered by small intestine.

The *sigmoid flexure* of the colon is situate in the left iliac fossa, to which it is attached by a fold of the peritoneum (sigmoid meso-colon), but it is often partly situate in the cavity of the pelvis. The intestine makes two turns like the letter S; whence its name. It is concealed by the small intestine, which is directed more to the left than to the right side. The extent of this part of the intestine is from the crest of the ilium to the junction of the same bone with the sacrum, where it ends in the rectum.

Sigmoid flexure is in left iliac fossa.

The *rectum* is the part of the large intestine which is contained in the pelvis, and it will be seen in the dissection of that cavity.

Rectum.

The liver. — The liver is situate in the epigastric and right hypochondriac regions, and sometimes reaches to the left hypochondrium. Folds of peritoneum (ligaments) retain it in its place.

Position of the liver.

The upper surface is convex, and turned to the diaphragm, and is divided into two parts by the suspensory ligament.

Surfaces.

The under surface is in contact with the ascending colon, the duodenum, the stomach, and with the right kidney. Attached to this surface is a fold of the peritoneum (small omentum) that contains hepatic vessels.

Borders. The anterior border is thin, and extends beyond the margin of the thorax in the erect position of the body: projecting beyond this edge is the gall bladder. The posterior border is thick, and is connected to the diaphragm by certain ligaments; it lies on the spine, on the large vessels (aorta and cava), and on the pillars of the diaphragm.

Position is changed by diaphragm, by posture of body, and by disease in other parts. The liver is moved by the ascent and descent of the diaphragm in respiration, and is therefore constantly changing its position. In inspiration the liver descends, and in expiration it regains its former level. In the upright and sitting postures the viscus descends an inch lower than in the horizontal condition of the body; so that, in the one state, the anterior border can be felt below the edge of the ribs, but in the other it is withdrawn within their margin. The connections of the liver with the surrounding parts may be changed by the growth of a tumour, or by collections of fluid in the chest or in the abdomen.

Situation of spleen. *The spleen.*—The spleen lies deeply in the left hypochondrium, between the stomach and the ribs, and is connected by peritoneum (splenic omentum) to the great end of the stomach on one side, and to the diaphragm on the other side.

Connections. Its position is almost vertical. Its outer surface is convex and corresponds to the diaphragm, and is opposite the ninth, tenth, and eleventh ribs; and the inner surface, which is concave, is in contact with the stomach and with the tail of the pancreas. Below the spleen are the kidney with its supra-renal capsule, and the beginning of the descending colon. When the stomach is distended the spleen is somewhat behind it.

Kidney *The kidney.* — The kidney should be examined on the left side, in order that the duodenum may not be displaced. To see it, detach the descending colon and the peritoneum from the abdominal wall. This viscus is surrounded with fat, and

occupies lumbar region. is situate in the lumbar region (one on each side), opposite the last dorsal and the two or three upper lumbar vertebræ.

Its position is somewhat oblique, so that the upper part is nearer than the lower end to the spinal column, and the right kidney is rather lower than the left. In front of the kidney are the peritoneum and the colon, with a small part of the duodenum on the right side, and the edge of the spleen on the left side. Behind it are the quadratus lumborum and psoas muscles, and the part of the diaphragm covering the last two ribs. Above the left kidney is the spleen, above the right one the liver, and below each is the crest of the ilium. Resting on the upper part of each kidney is the suprarenal capsule. The inner border looks to the spine and receives the vessels. Sometimes the two are united in front of the aorta, forming the horse-shoe kidney.

Right rather lowest. Parts in front, behind, above, below.

The *connections* of the *pancreas* will be omitted for the present.

Pancreas.

PERITONEUM.

This is the largest serous membrane in the body. Like other membranes of this kind it is a closed sac, except in the female, where it is continuous with the lining of the Fallopian tubes. One part of it lines the wall of the abdomen (parietal layer), and another is reflected over the different viscera, except where the vessels enter (visceral layer). Its inner surface is smooth, but the outer is rough when detached from the parts with which it is in contact. The folds of the membrane that attach the viscera to the abdominal wall, or pass from viscus to viscus along the vessels, consist for the most part of two layers, one on each side of the vessels.

Peritoneum consists of a parietal and visceral layer, and forms folds on vessels.

It is customary to trace the continuity of the sac both in a vertical and in a horizontal direction.

Circle around the abdomen.—If the membrane is followed outwards from the umbilicus it is found partly to enclose the large intestine, and to fix it to the abdominal wall. From that intestine it is continued over the kidney to the middle line, where it is reflected along the vessels to the small intestine, then over the intestine, and back to the spine along the other aspect of the vessels. Lastly it is continued outwards to the colon of the opposite side, and along the wall of the abdomen to the umbilicus. The mem-

Continuity of the membrane around the body, opposite umbilicus.

brane that fixes the colon to the abdominal wall is named meso-colon, and that attaching the small intestine is the mesentery.

Continuity of the serous membrane from above down;

Circle from above downwards.—Beginning at the liver, the student will perceive that the pieces of peritoneum covering the anterior and posterior parts of that viscus are prolonged from the under surface on the vessels. From the liver they may be followed along those vessels, one piece before and the other behind, forming the small omentum, to the upper border of the stomach. Separating to enclose the stomach, the pieces or layers are applied to one another beyond that viscus, to form the great omentum or epiploon. After descending to the lower part of the abdomen, they turn backwards and upwards, and may be seen to enclose the transverse colon like the stomach, and then to be continued to the spine, giving rise to the transverse meso-colon. At the attachment of the transverse meso-colon to the spine, the two companion layers will be found to separate, one passing upwards, the other downwards.

forms pouch of omentum,

The ascending piece is continued in front of the pancreas and the pillars of the diaphragm to join the peritoneum on the posterior part of the liver, and to form the posterior part of a pouch or bag, which is behind the stomach.

and descends over the intestine to the pelvis.

The descending piece or layer can be followed from the transverse meso-colon along the middle line of the spine, over the duodenum and the great vessels on the spine (aorta and cava), till it meets with the artery to the small intestine, along which it is continued to form the mesentery, as before explained in tracing the peritoneum in a circular direction. From the root of the mesenteric artery the peritoneum descends to the pelvis, and partly covers there the viscera. Thus it surrounds the upper part of the rectum, and attaches it to the abdominal wall by the meso-rectum; next, it is continued forwards between the rectum and the bladder, or between the rectum and the uterus, where it forms a pouch; thence it passes from the pelvis over the back and sides of the bladder. Lastly, the serous membrane is continued to the inguinal region, where it forms the pouches before alluded to (p. 443.); and it can be traced upwards on the wall of the abdomen and on the diaphragm to the surface of the liver.

Chief folds of the peritoneum.

Folds of the peritoneum.—After tracing the continuity of the serous sac over the viscera, the student should examine the chief folds or processes of the membrane, viz. the small and the great omentum, and the several folds that attach the small and the large intestine to the abdominal

wall. The pieces of the membrane that fix the liver, the bladder, and the uterus are named ligaments.

The *small* or *gastro-hepatic omentum* is stretched between the under surface of the liver and the upper border of the stomach, and contains the vessels and nerves of the liver. It is formed by two pieces of peritoneum, as before explained, and presents a free border on the right side. Behind it is the space called foramen of Winslow. Its lower border is fixed to the small curve of the stomach; whilst its upper border is attached to the transverse fissure and to the posterior half of the longitudinal fissure of the liver, becoming blended with the left lateral ligament of that viscus. Small omentum. Situation. Attachments.

The *gastro-colic* or *great omentum* is the largest fold of the peritoneum, and consists of two pieces or layers, continuous with those on the front and back of the stomach. It is attached to the spleen and to the lower border of the stomach, where the pieces are separated by vessels, and then descends in front of the intestines, but lower on the left than on the right side of the body. At the lower part of the abdomen the membrane is bent back, and returns towards the spine, the pieces of which it is composed separating and enclosing the transverse colon as before seen. Between the layers of this fold are contained some fat, and some vessels and nerves; and the power of separating one from another diminishes with the increase of the distance from the stomach, until at last the membrane they form is thin and net-like. The anterior part of the fold is separated from the posterior by a space (bag of the omentum) that extends a varying distance. Great omentum. Attachments. Forms a fold in front of small intestine. Consist of two layers.

a. Cavity or bag of the great omentum.—When an opening is made through the great omentum, near the stomach, and this viscus is raised, a large space is seen to extend upwards to the liver, and downwards into the omentum. This is the omental sac. In front the space is bounded by the small omentum, the stomach, and the anterior part of the great omentum. Behind it are the posterior part of the great omentum, the transverse colon, the transverse meso-colon, and the ascending layer of the transverse meso-colon. Above is the liver, and below is the doubling of the great omentum. This bag communicates with the rest of the peritoneal Bag of the omentum. Boundaries. Opens

into general cavity by foramen of Winslow. cavity, through the space behind the small omentum (foramen of Winslow). If the bag of the omentum were perfect, it could be inflated through the foramen; or if detached from the surrounding parts, it could be drawn through the same hole into the general bag of the peritoneum. Supposing it to be detached and drawn out, the following parts would have peritoneum taken from them, viz. the small omentum (posterior piece), the posterior part of the stomach, the great omentum (inner piece), the upper aspect of the transverse colon, the pancreas and the spine, and the posterior part of the liver. Should this piece of peritoneum be removed, there is not any hindrance to the vessels reaching the different viscera; and it may readily be conceived how the detached membrane could be replaced over the viscera and the vessels, without being perforated by these.

Foramen of Winslow. *b.* The *foramen of Winslow* is the space behind the small omentum, through which the bag of the omentum opens into the general cavity of the peritoneum. In front of it is the small omentum, and behind are the vena cava and the spine. Above it is the liver (lobulus Spigelii), and below is the duodenum. Should this hole be closed by inflammation, there may be a dropsical collection either in the bag of the omentum, or in the general bag of the peritoneum.

Splenic omentum. The *splenic omentum* reaches from the great end of the stomach to the concave surface of the spleen. It contains the vessels that pass between the two viscera, and is continued inferiorly into the great omentum.

Peritoneum attaching large intestine forms *Folds on the large intestine.* — The large intestine is connected to the wall of the abdomen by a fold of the peritoneum (meso-colon), which is formed of two pieces, as the other folds. Each part of the large intestine has a separate meso-colon: thus there is an ascending, a transverse, a descending, and a sigmoid meso-colon: the cæcum is also fixed by a meso-cæcum, and the rectum by a meso-rectum.

Meso-cæcum. *a.* The *meso-cæcum* attaches the cæcum to the right iliac fossa. Usually the peritoneum does not surround the cæcum so as to form a fold behind it, but in some instances the serous membrane does give a suspensory band to that part of the intestine.

Ascending, descending, *b.* By the *ascending* and the *descending meso-colon*, the ascending and the descending part of the colon are kept in place. In these folds, as in that of the cæcum, the peritoneum is not in contact

behind the intestine. The *sigmoid meso-colon* is longer than the preceding, and attaches the sigmoid flexure of the colon to the left iliac fossa. The *meso-rectum* contains the hæmorrhoidal vessels, and connects the rectum to the front of the sacrum. and sigmoid meso-colon.

c. The *transverse meso-colon* is a more perfect fold than either of the others that are attached to the large intestine, and serves as a partition between the small intestine and the stomach, liver, and spleen. By one side it is fixed to the colon, and by the other side to the abdominal wall below the pancreas. It is formed of two layers of peritoneum, as before said, which enclose the vessels of the colon. Transverse meso-colon,

Small processes of the peritoneum are attached along the tube of the great intestine, chiefly to the transverse colon; they are the *appendices epiploicæ*, and contain fat. Appendices epiploicæ.

Folds to the small intestine. — The small intestine is not enveloped by the peritoneum after the same manner through all its extent. For whilst the jejunum and ileum are attached to the abdominal wall by one fold (mesentery), the duodenum has special connections with the serous membrane. Peritoneal covering of small intestine.

Serous covering of the duodenum. — The first part of the duodenum is surrounded by peritoneum, like the stomach; the next part of the intestine is covered only in front; and the last part, that crosses the aorta, is but slightly in contact with the serous membrane, for at first it lies between the layers of the transverse meso-colon, and then beneath the upper part of the superior mesenteric artery. Peritoneum on duodenum.

The *mesentery* supports the small intestine (jejunum and ileum), and is stronger than any other fold of the serous membrane. It is narrowed at the spine, and its attachment thereto extends from the left side of the second lumbar vertebra to the junction of the right os ilii with the sacrum. The other end of the fold is wide, and is connected with the intestine. Between its two layers are placed the superior mesenteric vessels and nerves, with lymphatic glands and lacteals. Mesentery. Form. Attachments. Parts contained in it.

Ligaments of the liver. — The reflections of the peritoneum from the diaphragm and from the wall of the abdomen support the liver in the right hypochondrium, and are named ligaments. There is a suspensory ligament along the upper part, containing the obliterated umbilical vein, and a coronary ligament along the posterior border. Peritoneal folds of the liver.

Suspensory ligament. The *suspensory* or *falciform ligament* is placed between the upper convex surface of the liver and the abdominal wall. Shape. It is falciform in shape, and the base is turned forwards, and the apex backwards. Attachments. The lower border is concave, and is attached to the liver; whilst the opposite border is convex, and is connected to the abdominal wall, on the right of the linea alba, and to the under part of the diaphragm. Contains round ligament. In its base or free part is contained the remains of the umbilical vein, or the *round ligament.* How formed. This fold is produced by the passage of the umbilical vein to the liver, without piercing the peritoneum; and with a little care the dissector will be able to detach the serous membrane from the vein, and to trace the sac upwards on each side of it into the suspensory ligament.

Coronary ligament The *coronary ligament* is a short process of the peritoneum, which is reflected from the diaphragm to the liver, and is attached to all its posterior margin. But the ligament is enlarged at each side, forming a triangularly shaped piece, to which the terms right and left triangular ligaments have been applied.

gives rise to left and *a.* The *left triangular* or *lateral ligament* is attached above the edge of the left lobe, and is formed by two pieces of peritoneum, which are in contact; it lies in front of the œsophageal opening in the diaphragm.

right lateral triangular ligaments. *b.* The *right triangular* or *lateral ligament* lies deeply in the hypochondriac region, but the two pieces of peritoneum in it are not close together, like those of the left ligament. Its position is in front of the vena cava inferior.

MESENTERIC VESSELS AND SYMPATHETIC NERVE.

Vessels of intestine. The mesenteric arteries (superior and inferior) are two large visceral branches of the aorta, which supply the intestinal tube, except the duodenal part. Each is accompanied by a vein, and by a plexus of nerves of the same name derived from the sympathetic.

Dissection of superior mesenteric. *Dissection of the superior mesenteric vessels and nerves.* — To expose the superior mesenteric vessels and nerves, place the great omentum and the transverse colon on the margin of the ribs, and remove one layer (anterior) of the mesentery, following the arterial

branches to the small intestine. Whilst cleaning the artery in the mesentery, the student will meet with corresponding veins, and with offsets of the sympathetic nerves on the arteries. Some mesenteric glands and a few lacteal vessels will come into view at the same time. The branches from the right side of the vessel to the large intestine are next to be followed. After all the branches are cleaned, the trunk of the artery should be traced back beneath the pancreas, and the plexus of nerves surrounding it should be defined.

Superior mesenteric artery.

The *superior mesenteric artery* supplies branches to the small intestine beyond the duodenal part, and to half the large intestine, viz. as far as the end of the transverse colon. Arising from the aorta near the diaphragm, the vessel is directed downwards between the layers of the mesentery, forming an arch with the convexity to the left side, and terminates in offsets to the cæcum and to the end of the small intestine. At first the artery lies beneath the pancreas and the splenic vein; and as it descends to the mesentery it is placed in front of the duodenum and the left renal vein. This vessel is surrounded by the mesenteric plexus of nerves, and is accompanied by the vein of the same name.

Courses to intestine in the mesentery.

Connections

and branches.

Branches. — Whilst the vessel is covered by the pancreas it gives a small branch to that body and the duodenum. The other branches are intestinal; those from the left or convex side of the vessel supply the jejunum and ileum (rami intestinales); and those from the opposite side supply the colon, and are named colic arteries.

Pancreatico-duodenal.

The *pancreatico-duodenal branch* (inferior) is of small size, and after giving twigs to the pancreas, extends from left to right along the concavity of the duodenum, and anastomoses with the other duodenal branches.

Branches to small intestine.

Number

The *branches to the small intestine*, viz. to the jejunum and ileum, are about twelve in number, and pass from the left side of the mesenteric artery, between the layers of the mesentery, to their destination. About two inches from their origin, or sooner, the branches bifurcate, and each resulting branch unites with a similar part from the collateral artery, so as to form a series of arches. From the convexity of these arches other branches take origin, which divide and unite in the same way. This process is repeated four or five times between the origin and distribution of the arteries, but at each branching the size of the vessel diminishes. From

and arrangement in arches.

Distribution on the gut. the last set of arches, branches pass on both sides of the intestine, and anastomose round that tube, supplying its structure.

Arteries of large gut. The *branches to the large intestine* are three in number, ilio-colic, right colic, and middle colic arteries.

Ilio-colic branch *a.* The *ilio-colic* artery, or the continuation of the mesenteric trunk, descends to the cæcum and divides into branches that encircle the head of the colon, like the tube of the small intestine. A descending branch is distributed to the lower part of the ileum, ends on cæcum. the cæcum, and the vermiform appendix; and an ascending branch supplies the beginning of the ascending colon, and anastomoses with the right colic artery.

Right colic branch supplies ascending colon. *b.* The *right colic artery* is commonly an offset of the preceding, instead of a separate branch from the trunk. Its course is to the right or ascending colon, near which it divides into an ascending and a descending piece, and anastomoses with the ilio-colic artery on the one side, and the middle colic on the other. This artery gives ramifications to the ascending colon.

Middle colic branch passes to transverse colon. *c.* The *middle colic branch* arises from the upper part of the superior mesenteric artery, opposite the transverse meso-colon. Entering between the layers of that fold of the peritoneum, the vessel divides into two large diverging branches:—one, the right branch, anastomoses with the artery to the ascending colon, and the other (left) inosculates on the descending colon with a branch (left colic) of the inferior mesenteric artery. They form arches before entering intestine. The intestinal branches to the transverse colon are supplied from these two divisions, but before entering the gut they are united in arches like those to the small intestine.

Superior mesenteric vein. The *superior mesenteric vein* commences in that part of the intestinal tube to which the artery is distributed. The branches of origin unite into one trunk that accompanies the artery beneath the pancreas, and there joins the splenic vein to form the vena portæ.

Mesenteric glands The *mesenteric lymphatic glands* are numerous between the layers of the mesentery, and are lodged in the intervals between the branches of the vessels. Along the large intestine are a few lymphatic glands, *meso-colic*, which receive receive lymphatics of small, and of part of large intestine. the lymphatics of the large intestine. The lactiferous or chyliferous vessels of the small intestine, and the lymphatics of the part of the large intestine supplied by the superior mesenteric artery, pass through the mesenteric glands to reach the thoracic duct.

Dissection of the inferior mesenteric vessels and nerves.—After the small intestines are drawn over to the right side, the inferior mesenteric artery will be observed on the front of the aorta, a little above the bifurcation of that vessel. The dissector should remove with care the peritoneum from the vessel, and trace its branches outwards to the remaining half of the large intestine. The part of the artery that enters the pelvis will be afterwards dissected. On the artery and its branches is the inferior mesenteric plexus of nerves. The mesenteric vein is likewise to be traced upwards to its junction with the splenic, or with the superior mesenteric vein. On the aorta the student will meet with a plexus of nerves which is not to be injured. Dissection of inferior mesenteric.

The *inferior mesenteric artery* supplies branches to the part of the large intestine beyond the transverse colon, and communicating with the superior mesenteric, maintains the chain of anastomosis from the one end to the other of the intestinal tube. This vessel is of smaller size than the superior mesenteric, and arises from the aorta from one to two inches above the bifurcation. At first the vessel descends on the aorta, and then crosses the left common iliac artery in its course to the pelvis, where it ends in branches to the rectum (superior hæmorrhoidal). The following *branches* are furnished by it to the descending colon and the sigmoid flexure. Inferior mesenteric artery. Place of origin. Course and branches.

The *left colic artery* ascends in front of the left kidney, and divides into ascending and descending branches for the supply of the descending colon. By the ascending branch it anastomoses with the middle colic branch of the superior mesenteric artery. Left colic branch to the descending colon.

The *sigmoid artery* is distributed to the sigmoid flexure. Passing almost transversely outwards, it divides into branches that anastomose above with the preceding colic branch, and below with the hæmorrhoidal. Here, as in the rest of the intestinal tube, arches are formed by the arteries destined for the supply of the intestine. Sigmoid branch to sigmoid flexure.

The *superior hæmorrhoidal artery* enters between the layers of the meso-rectum, and is distributed to the lower part of the great intestine. It will be described in the dissection of the pelvis. Branch to rectum.

The *inferior mesenteric vein* begins in the part of the great intestine to which its companion artery is distributed, and ascends along the psoas muscle, away from the artery, Inferior mesenteric vein.

to open into the splenic vein beneath the pancreas. Occasionally it joins the superior mesenteric vein.

Veins of intestine without valves. The mesenteric veins are without valves, and may be injected from the trunk to the branches like an artery.

Lymphatic glands. *Lymphatic glands* are found by the side of the descending colon and the sigmoid flexure. The lymphatics from these parts, after passing through the glands, enter the left lumbar lymphatic glands.

Some plexuses of the sympathetic to the viscera. SYMPATHETIC NERVE. — The following plexuses of the sympathetic, which are derived from the solar plexus beneath the stomach, are in connection with the vessels that are now exposed, viz. superior mesenteric, aortic, spermatic, inferior mesenteric, and hypogastric. The remaining parts of the sympathetic nerve in the abdomen will be subsequently referred to.

Dissection of the nerves. *Dissection.* — On the mesenteric arteries the dissector has already exposed the plexuses of nerves that are distributed to the intestinal tube beyond the duodenum. It now remains to trace on the aorta itself the connecting nerves between the mesenteric plexuses. By taking the peritoneum from the aorta between the mesenteric vessels, the aortic plexus will appear; and by removing the serous membrane from the front of the sacrum, and following downwards, over the iliac arteries, the nerves from the aortic plexus and the lumbar ganglia, the dissector will arrive at the hypogastric plexus of the pelvis. From the upper part of the aortic plexus an offset is to be followed along the spermatic artery; this may be done, on the left side, where the artery is partly exposed.

Superior mesenteric plexus is on artery of same name. The *superior mesenteric plexus* is a large offset on the mesenteric artery and its branches, and is distributed to the same extent of the intestinal tube as the vessel supplies. The nerves closely surround the artery with a sheath, and are at first covered by the pancreas. In the mesentery, near the intestine, some of the nerves leave the arteries, and divide and communicate with others before entering the gut.

Its secondary plexuses. The secondary plexuses are the same as the branches of the artery, viz. intestinal nerves to the small intestine; and an ilio-colic, a right colic, and a middle colic plexus to the large intestine.

The *aortic plexus* is a network of nerves, that covers the aorta below the superior mesenteric artery. Superiorly it is continuous with the solar plexus, and inferiorly it ends in branches that cross the common iliac artery on each side, and enter the hypogastric plexus of the pelvis. From it an offset is furnished to the two visceral arteries of the aorta below the renal and superior mesenteric trunks, viz. to the spermatic and inferior mesenteric arteries. Aortic plexus is derived from solar plexus. Offsets.

The aortic plexus is stronger on the sides than on the front of the aorta, in consequence of its receiving accessory branches from the lumbar ganglia, especially the left. At the upper part the plexus seems to be derived from an offset on each side of the aorta, which is connected with the solar and renal plexuses. This plexus is best marked on sides of aorta.

The *spermatic plexus* is formed by an offset from both the aortic and the renal plexus. The nerves from it run on the spermatic artery to the testicle. In the cord they join other filaments on the vas deferens. Spermatic plexus.

In the female, the nerves on the spermatic (ovarian) artery are supplied to the ovary and to the uterus. In female.

The *inferior mesenteric plexus* surrounds the trunk and branches of the artery of the same name, and is supplied to the same part of the intestinal tube as the artery is distributed to. This plexus is furnished from the left part of the aortic plexus, and the nerves composing it are whiter and larger than in either of the preceding offsets of the sympathetic. Near the intestine (sigmoid flexure) the branching of the nerves and the union of the contiguous twigs are well marked. Inferior mesenteric plexus. Nerves join like the vessels.

The following secondary plexuses are supplied to the arteries of the same name, and are distributed like them to the intestine, viz. the left colic, the sigmoid, and the superior hæmorrhoidal plexus. Secondary plexuses.

On the intestinal tube the nerves of one plexus join those of another. Thus the superior mesenteric joins by one end the nerves to the duodenum, and by the other the nerves to the large intestine from the inferior mesenteric plexus. And the inferior mesenteric plexus communicates below with branches to the rectum from the hypogastric centre. Union of the nerves on the intestinal tube.

The *hypogastric plexus*, or the large prævertebral centre Hypo

gastric plexus. Situation. for the supply of nerves to the viscera of the pelvis, is situate in front of the upper part of the sacrum and beneath the peritoneum. It is developed more on each side than in the centre; and the nerves, which are large and flat, have a plexiform arrangement, but without any ganglionic masses on them. In it aortic plexus ends; By its upper part the plexus receives on each side the termination of the aortic plexus; and it is joined by some filaments from one or two of the upper sacral ganglia. and from it offsets are sent to pelvic viscera. Inferiorly the plexus ends in two parts, right and left, the last being the largest, which are continued forwards with the branches of the internal iliac artery to the viscera of the pelvis.

CONNECTIONS OF THE AORTA AND VENA CAVA.

Parts around aorta and cava. The connections of the *abdominal aorta* and of the *vena cava* may be next looked to before the viscera are removed from the body.

Dissection to see them. *Dissection.* — The part of the abdominal aorta below the origin of the superior mesenteric artery is laid bare by the previous dissection. To see it higher up, it will be necessary to detach the great omentum from the stomach, without injuring the gastro-epiploic artery, and after raising the stomach and the spleen to remove the peritoneum from the surface of the pancreas. A short arterial trunk (cæliac axis) above the pancreas is not to be cleaned now, otherwise the nerves about it would be destroyed. The vena cava will be exposed at the same time as the aorta.

Aorta lies in middle of spine. The *aorta* enters the abdomen between the pillars of the diaphragm, and divides into iliac arteries opposite the left side of the fourth lumbar vertebra. At the diaphragm the vessel occupies the middle line of the spine, but it gradually inclines to the left as it descends. Parts around. In the abdomen the aorta is covered at first by the solar plexus, and by the pancreas and the splenic vein; still lower (beyond the superior mesenteric artery) by the duodenum, and by the left renal vein; and thence to its termination by the peritoneum and the aortic plexus. The aorta lies on the lumbar vertebræ, and to its right side is the vena cava. Branches. Its branches are furnished to the viscera and to the wall of the abdomen, but these will be enumerated farther on.

The *vena cava inferior* commences on the right side of the fifth lumbar vertebra by the union of the common iliac veins, and reaches from that spot to the heart. In the abdomen this venous trunk is placed on the right side of the vertebral column, and is concealed by the same parts as the aorta. As high as the crus of the diaphragm it is close to the aorta, but above that spot it ascends on the right of the crus, and is imbedded in the posterior part of the liver. Lastly, it leaves the abdomen by an aperture in the tendinous part of the diaphragm, on the right of the aortic opening. The vena cava is joined by some branches from the abdominal viscera, and by others corresponding to the branches of the aorta that are supplied to the parietes of the abdomen.

Vena cava; extent and connections; is by the side of the aorta, except above.

Branches.

CONNECTIONS OF THE DUODENUM AND PANCREAS.

The situation and the connections of the duodenum and pancreas should be next examined.

Dissection. — To see distinctly the duodenum and the pancreas, it will be necessary for the dissector to take out the intestinal tube, beyond the duodenum, in the following way: one ligature is to be placed on the upper part of the jejunum, another on the lower end of the sigmoid flexure of the colon, and the gut is to be cut through at the points at which it is tied. The detached piece of the intestinal tube is to be removed by cutting through the vessels and the peritoneum that connect it to the wall of the abdomen, and is to be set aside for examination when the body is turned. To clean the viscera, and the cœliac vessels and nerves, the student should moderately inflate the stomach and duodenum from the cut extremity of the latter. By turning upwards the stomach the student will be able to trace the pancreas from the spleen on the one hand to the duodenum on the other, and by raising the duodenum, to find the common bile duct between it and the head of the pancreas.

Remove intestine

to see the blood vessels, duodenum, and pancreas.

Duodenum. — The first part of the small intestine, or the duodenum, begins at the small end of the stomach, and, crossing the spinal column, ends on the left side of the second lumbar vertebra. It takes a curved direction around the head of the pancreas, and occupies the right hypochon-

Extent of duodenum;

course and situation.

driac, the right lumbar, and the umbilical region of the abdomen. Its peritoneal covering is incomplete and peculiar (p. 457.), and its course around the pancreas is divided into three parts — superior transverse, vertical, and inferior transverse.

Divisions.

First part is shortest, and is moveable.

The superior transverse part is free and moveable, like the stomach; it measures about two inches in length, and is directed from the pylorus to the neck of the gall bladder, ascending slightly in its progress from one point to another. In front it is overlapped by the liver, as well as by the gall bladder when this is distended; and behind it are the bile duct and the vena portæ.

Second part is fixed,

The vertical part is fixed almost immoveably by the peritoneum and the pancreas. It is nearly three inches in length, and descends from the gall bladder as far as the third lumbar vertebra. Superficial to this part is the right bend of the colon, and beneath it are the kidney and its vessels, whilst on its inner side is the head of the pancreas, with the common bile duct. The ducts of the pancreas and liver pour their contents into this piece of the duodenum.

and rests on the kidney.

The third part is the longest,

The inferior transverse part is the longest of the three, and is continued across the spinal column to end in the jejunal portion of the small intestine. As it crosses the spine it corresponds to the attachment of the transverse meso-colic fold of the peritoneum, being between its layers, and has the following connections with the parts around: — In front of it are the superior mesenteric vessels, with their plexus of nerves; beneath it lie the aorta and vena cava, with the pillars of the diaphragm, and sometimes the left renal vein is between it and the aorta; above it is the pancreas.

and is moveable.

Parts around it.

Form and situation of the pancreas.

Pancreas. — The pancreas is situate behind the stomach, and has numerous and complicated connections. Of an elongated form, it extends across the spine from the spleen to the duodenum, and occupies the left hypochondriac, the umbilical, and the right lumbar region of the abdomen.

Its connections by the surfaces

The gland is covered anteriorly by the ascending layer of the transverse meso-colon, and is in contact posteriorly with

the aorta, the vena cava, and the pillars of the diaphragm; it likewise conceals the splenic vein and the commencement of the vena portæ. Projecting above the upper border, near the centre, is the arterial trunk of the cœliac axis; to the left of that vessel, along the same border, is the splenic artery, whilst to the right of it are the hepatic artery and the first part of the duodenum. At the lower border, the superior mesenteric vessels are seen emerging opposite the cœliac axis, but to the right of that spot is the third part of the duodenum, and to the left of it the inferior mesenteric vein ascending to join the splenic. The left end or the tail of the pancreas touches the spleen, and rests on the left kidney; and the right extremity, or the head of the gland, is received into the concavity of the duodenum, the two being partly separated behind by the common bile duct, and in front by the pancreatico-duodenal artery. borders and extremities.

VESSELS AND NERVES OF THE CHYLO-POIETIC VISCERA.

The arteries that are furnished to the stomach, duodenum, liver, pancreas, and spleen are derived from the cœliac axis (a branch of the aorta), which subdivides into coronary, hepatic, and splenic branches. The veins corresponding to these vessels are collected into one trunk—the vena portæ; and the nerves are supplied from the vagus and the sympathetic nerves.

Dissection.—The vessels that are now to be learnt have been in part laid bare by the previous dissection, and the preparation of them will be completed by the removal of the cellular membrane and the peritoneum. Before beginning his task the dissector should take care that the liver is well raised, and in the execution of it let him spare the plexuses of nerves that surround the vessels. Starting from the cœliac axis, the student may first follow to the left side the small coronary artery, and clear its branches to the œsophagus and stomach. Next the hepatic artery, with the vena portæ and the bile duct, are to be traced to the liver and the gall bladder, and a considerable branch of it is to be pursued beneath the pylorus, together with its branches to the stomach, duodenum, and pancreas. Lastly, the splenic artery that lies along the upper border of the pancreas is to be cleaned, and its branches to How to dissect cœliac axis and its several branches.

the pancreas, stomach, and spleen defined. The veins are dissected for the most part with the arteries, but the origin of the vena portæ is to be made evident beneath the pancreas.

This trunk supplies the three following branches:—

The CŒLIAC AXIS is the first visceral branch of the abdominal aorta, and arises from that vessel between the pillars of the diaphragm. It is a short thick trunk, about half an inch long, which projects above the upper border of the pancreas, and is surrounded by the nerves of the solar plexus of the sympathetic. Its branches — coronary, hepatic, and splenic, — radiate from the trunk (whence the name axis) to their destination to the viscera in the upper part of the abdomen.

Coronary, which gives

1. The *coronary artery* is the smallest of the three branches, and passes between the layers of the little omentum to the left orifice of the stomach. At that spot it furnishes some œsophageal branches, and then turns from left to right, along the upper border of the stomach, to anastomose with a branch (pyloric) from the hepatic artery. Its offsets to the œsophagus and the stomach are thus disposed of:—

offsets to the œsophagus

a. The *œsophageal branches* ascend on the gullet through the opening in the diaphragm, and after supplying that tube, anastomose on it with branches from the thoracic aorta.

and to the stomach.

b. The *gastric branches* are given to both sides of the stomach as the artery lies along it, and those to the left end communicate with twigs (vasa brevia) of the splenic artery.

Splenic artery

2. The *splenic artery* is the largest branch of the cœliac axis in the adult. It is a tortuous artery, and runs almost horizontally to the left, along the upper border of the pancreas, to reach the spleen. Near this body it divides into its terminal branches (*splenic*), which are about six in number (from four to ten), and enter the substance of the spleen by the concave surface, towards the stomach. In its course the vessel is accompanied by the splenic vein, which is below it, and it distributes branches to the pancreas, and to the stomach.

supplies the spleen,

the pancreas by large and small twigs,

a. Pancreatic branches.—Numerous small branches are supplied to the gland as the artery lies along it. And one of these, *art. pancreatica magna*, arises near the left end of the gland, and runs to the right with the duct, in the substance of the viscus.

b. The *branches for the stomach* arise from the divisions of the artery near the spleen. Some of these, *vasa brevia*, turn backwards to the left end of the stomach between the layers of the gastro-splenic omentum, and ramify in the coats of that organ. Another branch, *art. gastro-epiploica sinistra*, which is larger than the others, turns to the right, along the great curvature of the stomach, between the layers of the great omentum, and inosculates with the right gastro-epiploic branch of the hepatic artery. This artery distributes twigs to both surfaces of the stomach, as well as between the pieces of peritoneum forming the great omentum.

and the stomach by vasa brevia

and left gastro-epiploic.

3. The *hepatic artery* was the largest, in the fetus, of the three branches into which the cœliac axis divides; but in the adult it is intermediate in size between the other two, and is encircled by the largest plexus of nerves. In its course to the liver, the vessel is first bent to the right towards the small end of the stomach, where it supplies its principal branches (superior pyloric and gastro-duodenal). It then ascends between the layers of the little omentum, on the left side of the bile duct and vena portæ, and divides near the transverse fissure of the liver into two large terminal arteries—the right and left hepatic. Its branches are distributed not only to the liver, but freely to the stomach, the duodenum, and the pancreas.

Hepatic artery;

courses to the liver,

in which it ends,

and supplies

a. The *superior pyloric branch* descends to the upper border of the stomach, and running from right to left anastomoses with the coronary artery; it distributes small arterial twigs to both the anterior and the posterior aspect of the stomach.

offsets to the stomach.

b. The *gastro-duodenal artery* is a short trunk of considerable size, which descends beneath the duodenum near the pylorus, and divides at the lower border of the intestine into two branches: one for the stomach (right gastro-epiploic), and one for the pancreas and the duodenum (pancreatico-duodenal). As this trunk lies beneath the duodenum it supplies small *inferior pyloric* branches to the small end of the stomach.

Branches to the stomach, and duodenum, viz.—

inferior pyloric,

The *right gastric epiploic branch* (art. gast. epiploica dextra) turns from right to left along the great curvature of the stomach, between the pieces of the great omentum, and inosculates with the left gastro-epiploic branch of the splenic artery. Some branches are given upwards from it on the surfaces of the stomach, and others downwards between the layers of the omentum.

right gastro-epiploic,

The *pancreatico-duodenal branch* (superior) continues along the

and pancreatico-

duodenal. curve of the duodenum, lying between it and the pancreas, and anastomoses below with the pancreatic duodenal branch (inferior) of the superior mesenteric artery (p. 459.). Both the duodenum and the pancreas receive offsets from this vessel. Another small artery has a similar position and distribution on the posterior aspect of the viscera.

Branches to the liver; *c.* The *hepatic branches* sink into the liver at the transverse fissure, and ramify in its substance.

one for the right lobe and gall bladder, The *right branch* is divided when about to enter the liver at the right end of the transverse fissure, and supplies the following small artery to the gall bladder. The *cystic* artery, on reaching the neck of the gall bladder, divides into two twigs that ramify on the opposite surfaces, and are distributed to its coats.

and one for the left lobe. The *left branch* is smaller than the other, and enters the liver at the left end of the tranverse fissure. A branch to the Spigelian lobe of the liver arises from this division of the artery.

Three veins, viz.— VEINS.—The veins of the viscera of this part of the abdomen are three in number, viz. the superior coronary, the splenic, and the portal vein.

coronary from the stomach; The *superior coronary vein* lies along the upper border of the stomach. It begins in the œsophagus and the left part of the stomach, and joins the vena portæ at the pylorus.

splenic from the spleen, The *splenic vein* is of large size, and is formed by the union of branches that issue from the spleen. It takes much the same course as the artery, but is lower than it, and runs beneath the pancreas to the front of the cava, where it joins the superior mesenteric vein to form the vena portæ.

stomach, and pancreas. Between its origin and termination it receives branches corresponding to the following arteries, vasa brevia, left gastro-epiploic, and pancreatic; it is also joined by the inferior mesenteric vein about the middle of its length.

Vena portæ resembles an artery in its branching. The *vena portæ* conveys to the liver the blood that has been circulated through the following chylo-poietic viscera, viz. the alimentary canal, the pancreas, and the spleen. This vein commences by roots in the viscera above mentioned, like any other vein, but it is deficient in valves, and ramifies through the structure of the liver in the same manner as an artery.

Its origin, The vein results from the union of the splenic and superior mesenteric veins, and its origin is placed in front of the vena

cava, but beneath the pancreas, and about two inches from its right end. This vessel is about four inches long, and is directed upwards in the small omentum, behind the bile duct and the hepatic artery, to the transverse fissure of the liver, where it divides into a right and a left branch.

length, and termination.

In its course it is joined by the coronary or gastric vein, and by the cystic vein near the liver.

Accessory branches.

The *right branch* is sometimes joined by the cystic vein, and enters the transverse fissure to ramify in the liver.

The *left branch* is distributed to the left part of the liver, and gives a small branch to the Spigelian lobe of that viscus.

Terminal branches right and left.

Bile Ducts. — Two ducts issue at the transverse fissure of the liver, one from each lobe, and unite to form the *common hepatic duct.* The excretory tube, thus formed, is an inch and a half long, and after being joined by the duct of the gall bladder it is named the common bile duct.

Common hepatic duct; how formed.

The *common bile duct* (ductus communis choledochus), which is formed as above said, is about three inches long, and descends almost vertically beneath the upper transverse piece of the duodenum, and then between the pancreas and the vertical piece of the duodenum, to open into this part of the intestine at its inner margin, and above its middle. Before piercing the coats of the intestine, it is commonly joined by the pancreatic duct, but the two may enter the duodenum separately. Whilst in the small omentum, the duct lies to the right of the hepatic artery, and somewhat before the portal vein.

Common bile duct; length and course.

Termination.

SYMPATHETIC AND VAGUS NERVES.

Sympathetic Nerve. — In the abdomen the sympathetic nerve consists, as in the thorax, of a gangliated cord on each side of the vertebral column, and of prevertebral centres or plexuses, which furnish branches to the viscera.

General disposition in the abdomen.

Two prevertebral plexuses are found in the abdomen. One of these is the solar or epigastric plexus, which is placed behind the stomach, and supplies nerves to all the viscera above the cavity of the pelvis. The other is the hypogastric plexus, which is situate in the pelvis, and distributes nerves

Two large centres, solar and hypogastric.

to the pelvic viscera. The offsets or secondary plexuses of these centres accompany bloodvessels to their destination.

Part to be seen in the abdomen. The visceral part of the sympathetic nerve that remains to be seen, consists of the great epigastric centre, viz. the semilunar ganglia and solar plexus, with their offsets.

How to lay bare solar plexus. *Dissection.*—To expose the great prevertebral centre above mentioned, let the air escape from the stomach and duodenum; and after cutting through the portal vein, the common bile duct, and the gastro-duodenal artery behind the pylorus, turn the stomach, the duodenum, and the pancreas over to the left side. After the liver has been well raised, and some cellular tissue taken away, the vena cava appears. The vein is to be cut across above the junction of the renal vein with it, and the lower end is to be drawn down with hooks.

Semilunar ganglia. Beneath the vein the dissector will find the large reddish semilunar ganglion of the right side. From its inner part he should trace the numerous nerves which form the solar plexus around the cœliac and superior mesenteric arteries; and should unravel the offsets around those arteries with their secondary plexuses. From the outer part of the ganglion branches are to be traced to the kidney, the supra-renal body, and the diaphragmatic arteries. At the upper part of the ganglion the dissector will observe the large splanchnic nerve, and deeper than it, one or two other smaller splanchnic nerves that throw themselves into the solar and renal plexuses. Mixed up with the nerves of the solar plexus are numerous lymphatic glands and a dense cellular membrane, which require to be removed with care.

Follow the ending of the vagus nerves. The student should now trace the ending of the pneumogastric nerves on the stomach. The left nerve will be found in front near the upper border; and the right nerve will be seen at the opposite aspect. Branches are to be traced from the right nerve to the plexus of the sympathetic by the side of the cœliac axis, and from the left to the hepatic plexus.

Solar plexus; The EPIGASTRIC OR SOLAR PLEXUS is the largest of the prevertebral plexuses of the sympathetic, and furnishes nerves to all the viscera of the abdomen above the pelvis. appearance, It is a large network of nerves and ganglia, which lies in front of the aorta and pillars of the diaphragm, and extends from the supra-renal capsule of one side to that of the other. extent; It surrounds the cœliac axis and the superior mesenteric artery, and extends downwards to the pancreas. The plexus

is connected on each side with the large and small splanchnic nerves, and it is joined also by some twigs from the right pneumogastric nerve. Large offsets are furnished to the different viscera along the vessels.

gives offsets on blood vessels.

The *semilunar ganglia* of the solar plexus, one on each side, are the largest ganglia in the whole body. Each is situate at the upper and outer part of the plexus, close to the supra-renal capsule, and on the side of the pillar of the diaphragm. The ganglion of the right side is beneath the vena cava. Irregular in shape, the mass is sometimes oval, and at other times divided into smaller ganglia. From the outer side nerves are directed to the kidney and superrenal capsule, and to the inner side the cords of the solar plexus are connected. By the upper end it is joined by the great splanchnic nerve.

Semi-lunar ganglia: situation; form. Nerves connected with each.

Offsets of the plexus.—The nerves supplied to the viscera run on the branches of the aorta, forming plexuses around them; thus there are cœliac, mesenteric, renal, spermatic, and other plexuses. The diaphragmatic artery has also a separate plexus on it.

Several offsets of the plexus.

Diaphragmatic plexus.—The nerves that form this plexus come from the upper and outer part of the semilunar ganglion. They are placed at first on the phrenic artery, but they soon leave it to enter the substance of the diaphragm. A communication takes place between the phrenic nerve of the cervical plexus and these branches of the sympathetic.

Plexus to the diaphragm

On the under surface of the diaphragm is a small ganglion where the spmpathetic nerve joins the spinal nerve, and from it filaments are supplied to the vena cava and to the supra-renal body. The ganglion is absent on the left side.—(Swan.)

has a ganglion on right side.

The *supra-renal nerves* are directed almost horizontally outwards to the supra-renal body which they enter at the upper part. One of the splanchnic nerves communicates with this plexus.

Supra-renal nerves.

The *renal plexus* is derived from the semilunar ganglion, and from the outer part of the solar plexus, and it is further joined by one of the two smallest splanchnic nerves. The nerves surround the renal artery, having small ganglia on them, and enter the kidney with the vessels. An offset is

Renal plexus

joins spermatic. given from the renal nerves to the spermatic plexus (p. 463.).

Cœliac plexus The *cœliac plexus* is a direct continuation forwards of the solar plexus around the artery named cœliac axis. It is further joined by the small splanchnic nerve on each side, and by an offset from the right pneumogastric nerve.—(Swan.) The plexus surrounds the artery, and divides, like it, into three parts—coronary, splenic, and hepatic.

divides like the artery,

into coronary *a.* The *coronary plexus* accompanies the coronary artery to the upper border of the stomach which it supplies. It communicates with the left vagus nerve, and with the sympathetic on the pyloric artery.

splenic, *b.* The *splenic plexus* surrounds the splenic artery, and is conducted by it to the substance of the spleen. It furnishes, like the artery, pancreatic nerves, and other nerves to the stomach along the left gastro-epiploic artery. This plexus is joined by twigs from the left semilunar ganglion, and by an offset from the right pneumogastric nerve.

and hepatic. *c.* The *hepatic plexus* is continued on the vena portæ, the hepatic artery, and the bile duct to the transverse fissure of the liver, where it enters the liver and ramifies on the vessels. Whilst ascending in the small omentum the plexus is joined on the left side by offsets from the left vagus and phrenic nerves.—(Swan.)

The last has these secondary ones, Secondary plexuses are furnished around the branches of the hepatic artery, which have the same name and distribution as the vessels. The following are these plexuses:—

pyloric, A *pyloric* plexus accompanies the pyloric artery to the upper border of the stomach. A *gastro-duodenal* plexus surrounds the artery of that name, and divides like it into two plexuses—*gastro-epiploic* (right) and *pancreatico-duodenal*: the former meets nerves from the splenic plexus, and the latter communicates with the superior mesenteric plexus on the end of the duodenum. A *cystic* plexus is distributed to the gall bladder with its artery.

gastro-duodenal, epiploic, pancreatic, and cystic.

The remaining offsets of the solar plexus, viz. superior and inferior mesenteric, aortic, and spermatic, have been already described (page 462.); but the derivation of the superior mesenteric and aortic plexuses from the epigastric centre is now seen.

Ending of left vagus *Ending of the vagus nerve.*—In the abdomen the pneumogastric nerves are distributed to the stomach. The *left*

divides into branches, that extend over the front and along the small curvature of the stomach; these join, moreover, the sympathetic, and give offsets to the hepatic plexus. The *right* nerve is distributed to the posterior surface of the stomach, and communicates with the cœliac and the splenic plexus. and right.

Ending of the splanchnic nerves.—The *large nerve* perforates the crus of the diaphragm, and generally ends altogether in the semilunar ganglion, but it may give filaments to the renal plexus and to the supra-renal body. The *small nerve* comes through the same opening in the diaphragm as the preceding, and ends in the cœliac plexus; but it enters the renal plexus if the smallest splanchnic nerve is absent. The *smallest nerve*, after piercing the diaphragm, joins the renal plexus. Ending of large splanchnic nerve, small, and smallest.

Dissection.—The viscera are now to be removed from the abdomen in order that the body may be turned for the dissection of the back and other parts. The stomach and the spleen with the duodenum and the pancreas may be readily taken away when the œsophagus has been cut through near the diaphragm, and the vessels and nerves they receive have been divided. The liver is to be removed by cutting across its ligaments and dividing the vena cava between its posterior border and the diaphragm. At the same time the right kidney is to be taken out with its supra-renal body; and lastly the dissector should remove the left testicle by cutting through the cord. Prepare for turning the body.

Supposing the body now to lie with the face downwards for the usual time, the dissector will first examine the disposition of the fascia lumborum, or the posterior aponeurosis of the transversalis abdominis muscle, which is described in the DISSECTION OF THE BACK, page 363. Afterwards he should occupy the rest of the time in examining the form and structure of the viscera, as in the following section. Directions for the dissector.

Section IV.

ANATOMY OF THE VISCERA OF THE ABDOMEN.

THE STOMACH.

Definition. The stomach is a dilated pouch between the œsophagus and the small intestine, into which the food is received to be changed into chyme.

Separate and blow up the stomach. *Dissection.* — To see the form of the stomach, detach the spleen and cut through the duodenum near the pylorus. Then blow up the stomach moderately and clean the surface.

Form, direction, size, divisions. *Form and Divisions.* — The stomach is somewhat conical in form, and is directed obliquely across the abdomen, with the base or wider part turned to the left, and the apex to the right side. Its size varies much in different bodies, and is sometimes much diminished by a constriction in its centre. When the stomach is moderately distended, it is about twelve inches long and four wide. This viscus presents for examination two ends, two orifices, two surfaces, and two borders or curves.

Left end and right *Extremities.* — The left end or tuberosity (fundus ventriculi) is the largest part of the stomach, and projects about three inches to the left of the œsophagean opening. The right or pyloric end is much smaller than the other, is cylindrical, and forms the apex of the cone, to which the stomach is likened.

cardiac and pyloric openings; last has a valve. *Openings.* — The left opening (cardiac), which communicates with the œsophagus, is at the highest part of the stomach, and is funnel-shaped towards the cavity of the organ. The right or inferior opening (pylorus) opens into the duodenum, and is guarded internally by a valve. At the same spot the stomach is slightly constricted externally, where a firm circular ring may be felt.

Surfaces rounded or flat. *Surfaces.* — The surfaces are somewhat flattened when the stomach is empty, but rounded when it is distended. The parts in contact with the sides have been referred to (p. 448.).

Borders. — The upper border, or small curve of the stomach, is concave towards the left opening, but convex at the opposite end; and the lower border, or large curve, is convex, except near the right end, where it is concave. The concavity of the one border corresponds to the convexity of the other. An arterial arch and a fold of peritoneum (omentum) extend along each border.

Upper border; lower border, difference in outline.

STRUCTURE. — In the wall of the stomach are found four layers or coats, viz. a serous, a muscular, a cellular or fibrous, and a mucous, together with vessels, nerves, and lymphatics.

Four strata are in the stomach.

1. *Serous coat.* — The peritoneum gives a complete covering to the stomach, and is adherent to the surface except at the margins, where an interval exists corresponding to the attachment of the small and the large omentum. In this space are contained the vessels, nerves, and lymphatics of the stomach, surrounded by cellular membrane. During distension of the stomach, the space above mentioned is destroyed.

The serous coat is thin and adherent.

2. The *muscular coat* will be exposed by the removal of the serous covering. It consists of three sets of muscular fibres, viz. longitudinal, circular, and oblique, which lie from without inwards in the order mentioned. The fibres are unstriped, with a few exceptions in the outer layer.

The muscular coat is made up of

a. The *longitudinal fibres* are derived from those of the œsophagus; they spread over the surfaces, and are continued onwards to the pylorus and the small intestine. These fibres are most marked along the borders, particularly the smaller one, and at the pylorus they are much stronger than in the centre of the stomach.

longitudinal,

b. The *circular fibres* form the middle stratum of the muscular coat, and will be seen by removing the longitudinal fibres, especially near the pylorus. They reach from the cardiac to the pyloric end of the stomach, but at the latter part they are most numerous and strongest, and form a firm ring around the pyloric opening.

circular,

c. The *oblique fibres* are continuous with the circular or deep layer of fibres of the œsophagus, and form only part of a layer in the gastric wall. On the left of the cardiac orifice they are seen to arch over the great end of the stomach, and then to spread out

and oblique fibres.

on the anterior and posterior surfaces, gradually disappearing on them.

The cellular coat is thin, but firm.

3. *Fibrous or submucous coat.*—By removing the muscular layer over a small spot, the cellular or fibrous coat will appear as a white shining stratum. Formed of fine areolar tissue, this coat gives strength to the stomach, and serves as a bed in which the vessels and nerves ramify before their final distribution to the mucous coat. If a small opening is made in this membrane, the mucous coat projects through it when the stomach is distended with air.

Mucous coat;

4. The *mucous coat* will come into view on cutting open the stomach, but the appearances about to be described can be seen only in a recent stomach.

feel, colour, folds, thickness; disposition at pylorus.

This coat is a thickish layer, smooth and soft to the touch, which, in the natural and healthy condition, is found of a pale rose colour, soon after death. In infancy the natural redness is greater than in childhood or in old age; and in the empty state of the stomach the membrane is less vascular than during digestion. When the stomach is contracted, the membrane is thrown into numerous wavy lines or *rugæ*, which are longitudinal along the great curve, towards the pylorus. The thickness of the mucous membrane is greatest near the pylorus, and here it forms a fold opposite the muscular ring, which assists in closing the opening. If this membrane and its submucous layer are removed from the pyloric part of the stomach, the ring of muscular fibres (sphincter of the pylorus) will be more perfectly seen.

On the surface are pits or alveoli; their size, shape, and appearance near pylorus.

Microscopic structure of the mucous membrane.—With the aid of a lens the surface of the mucous membrane will be seen to be marked all over by shallow depressions or alveoli, which measure from $\frac{1}{200}$th to $\frac{1}{100}$th of an inch across. These depressions are occupied by the apertures of minute tubes. Generally hexagonal or polygonal in outline, these hollows become larger and more elongated towards the small end of the stomach. Near the pylorus, too, the margins of the alveoli project, and are irregular, so as to resemble rudimentary villi.

The texture made up

By means of a thin section under the microscope, the membrane is seen to be formed almost altogether of minute

vertical tubes that lie side by side, and project into the submucous cellular tissue. Measuring from $\frac{1}{60}$th to $\frac{1}{20}$th of an inch in length, the tubes open on the surface of the stomach both in the alveoli and in the inter-alveolar spaces, but are closed at the opposite or deep end. For the most part they are straight, but towards the pylorus they become longer, and somewhat sacculated at the deep extremity. Their interior is lined by columnar epithelium, which becomes spheroidal in the bottom of the tube; and filling them is a colourless fluid, which contains a granular material. of tubes of small size; mostly straight with closed deep end, lined by epithelium; contain fluid.

Over the surface of the mucous membrane small lentiform *follicles* are scattered, which have a depression in the centre. These are in greatest number near the pyloric end of the stomach, and are most marked in young children. Follicles.

A columnar *epithelium* covers the surface of the mucous membrane, and enters the small tubes, as before mentioned. On some parts of the surface of the stomach, the scaly or pavemental epithelium is also found. Epithelial covering.

Blood-vessels and nerves of the stomach.—The different *arteries* of the stomach, after supplying the muscular coat, ramify in the submucous cellular tissue, and terminate in the mucous coat. From that anastomosis in the submucous stratum small offsets are continued on the tubes to the inner surface of the mucous membrane, where they form a net-work. The *veins* begin in the mucous coat, receive branches from the muscular coat, and deliver their blood into the portal system. Two layers of *lymphatics*, superficial and deep, are found in the stomach. The *nerves* are derived from the pneumogastric and sympathetic, as before said, p. 474. Arteries, veins, lymphatics, and nerves.

SMALL INTESTINE.

The three parts into which the small intestine is divided, viz. duodenum, jejunum, and ileum, have the following differences in their characters:— Characters.

The *duodenum* measures about as much as the breadth of twelve fingers (about ten inches), and is more fixed than the rest of the intestinal tube. It is wider in capacity than either the jejunum or the ileum, and its muscular coat is also thicker. Into it the common bile duct and the pancreatic duct pour their contents. Length and fixedness. Width and thickness. Ducts entering it.

Length. The *jejunum* and the *ileum* together are about twenty feet long, and are connected to the mesentery by one border. There is not any perceptible difference between the termination of the one and the commencement of the other, but two fifths of the length are assigned to the jejunum, and three fifths to the ileum. At the ends, however, a marked difference may be observed, for the upper part of the jejunum is thicker and more vascular than the lower part of the ileum, and the width of the tube is also greater.

Division arbitrary. Differences at the ends.

Wall has same strata as the stomach. STRUCTURE.—In the small intestine the wall is formed by the same number of layers as in the stomach, viz. serous, muscular, cellular, and mucous; and these have the same position from within outwards. These different structures are to be examined on the duodenum, and on pieces taken from the upper part of the jejunum, from the lower end of the ileum, and from the middle of the small intestine. The pieces of intestine, when obtained, are to be distended with air.

Serous coat like that of the stomach, except in the duodenum. 1. The *serous coat* is closely connected with the subjacent muscular layer. To the greater part of the small intestine (jejunum and ileum) it furnishes an entire covering, except at the posterior aspect, where the vessels enter. At that spot a space exists, resembling those at the borders of the stomach, where the peritoneum is reflected off to form the mesentery. The peritoneum surrounds the duodenum only partly; this peculiarity has been described at p. 457.

Muscular coat is formed by a 2. The *muscular coat* is constructed of two sets of fibres, a superficial or longitudinal, and a deep or circular. The fibres are pale in colour, and are unstriped.

longitudinal *a.* The *longitudinal fibres* will be seen only by a careful removal of the peritoneum, for they are generally taken away with that membrane. They form a thin layer, which is most marked at the free border of the gut.

and a circular layer. *b.* The *circular fibres* are much more distinct than the others, and give the chief strength to the muscular coat: they do not appear to form complete rings around the tube of the intestine.

Cellular coat like that in 3. The *cellular coat* has the same position with respect to other parts, and the same use, as the corresponding layer in

the stomach. By the removal of a part of the muscular stratum, this submucous layer will come into view. In the upper part of the duodenum the student should seek the small compound glands, those of Brunner, which are imbedded in this tissue. They lie beneath the mucous membrane, and will be found when the muscular coat is taken away. Glands in it.

4. The *mucous coat* will be ready for examination when the pieces of intestine are opened and washed; but the gut should be cut along the line of attachment of the mesentery, so as to avoid Peyer's glands on the opposite side. The lining membrane of the small intestine is thicker and more vascular at the beginning than at the ending of the tube, and is marked by numerous prominent folds (valvulæ conniventes). The surface of the membrane is soft, and is covered with small points (villi). Occupying the substance of the mucous coat are numerous glands; and covering the whole is a columnar epithelium. Mucous coat; thickness, folds, and villous surface.

The *valvulæ conniventes* (valves of Kerkring) are permanent folds of the mucous membrane, which are arranged circularly, one after another, along the intestine, and project into the alimentary mass. Crescentic in form, they extend round the intestine for half or two thirds of its circle, and some end in bifurcated extremities. Larger and smaller folds are met with, sometimes alternating; and the larger ones are about two inches long, with two thirds of an inch in depth towards the centre. Each valve is formed of a doubling of the mucous membrane, which encloses cellular membrane and vessels between the layers. Folds or valves; arrangement, length, size and depth; how formed.

The valves begin in the duodenum, one to two inches beyond the pylorus, and are continued in regular succession to the middle of the jejunum; but beyond that point they become smaller and more distant one from another, and finally disappear about the middle of the ileum, having previously become irregular and rudimentary. The valvulæ are largest and most regular beyond and not far from the opening of the bile duct. Extent on the intestine.

The *aperture* of the *common bile* and *pancreatic ducts* is a narrow orifice, situate in a small prominence on the sur- Opening of bile duct;

where situate.

face of the mucous membrane of the duodenum, from three to four inches from the pylorus, and at the inner and posterior part of the intestine. A probe passed into the bile duct will show the obliquity of its course (half an inch) through the wall of the intestine. Sometimes the pancreatic duct opens by a distinct orifice.

Sometimes double.

Parts to be learnt in the intestine.

Microscopic structure of the mucous membrane.—With the use of the microscope, and with fresh pieces of intestine, the student will be able to make out the nature of the villi, the several glandular structures, and the epithelium.

The villi cover the surface;

Villi.—When the mucus is washed away from a piece of the lower part of the duodenum, and this is examined in water, the surface of the mucous membrane is found to be studded over very thickly with small projections, which give it the appearance of velvet. Existing along the whole of the intestine, both on the valves and between them, these bodies are irregular in form, some being triangular, others conical or cylindrical with a large end. Their length is from one fourth to one third of a line. They are best marked where the valvulæ conniventes are largest, where their number is estimated at 50 to 90 in a square line; but in the lower end of the ileum at only 40 to 70 in the same extent of intestine.—Krause.

their shape, size,

and number.

Composition.

Each villus is an extension of the mucous coat, which contains a capillary net-work of arteries, mostly a single vein, and lacteal vessels. The entire surface of each is invested with columnar epithelium.

Several kinds of glands.

Glands.—In the glandular apparatus of the small intestine are included the crypts of Lieberkuehn, some solitary glands, and Peyer's and Brunner's glands.

Simple tubes as in the stomach, but not so close;

The *crypts of Lieberkuehn* are minute simple tubes, similar to those in the stomach, though not so closely aggregated, that are found throughout the small intestine. These tubes open on the surface of the mucous membrane, by small orifices, between the villi and around the larger glands; but at the opposite end they are closed, and project into the submucous cellular layer. Their length is from $\frac{1}{30}$th to $\frac{1}{20}$th of a line, and their diameter is $\frac{1}{50}$th of a line. They are

their size

filled with a clear fluid that contains granules, and are lined by epithelium. and contents.

The *solitary glands* are roundish white eminences, about the size of a millet seed, which are scattered along the whole extent of the small intestine, but rather in greatest number at its lower part. Placed on any side of the intestine, or even on or between the valvulæ conniventes, these bodies are covered by the villi of the mucous membrane, and have around them the apertures of the crypts of Lieberkuehn. These glands are small sacs, which contain an opaque whitish granular fluid, but have not any aperture into the intestine.

Solitary simple glands; size and situation. Closed sacs.

The *glands of Peyer* (glandulæ agminatæ) are found chiefly in the ileum, in the form of oval patches, which measure from half an inch to two inches or more in length, and about half an inch in width. These glands are situate on the part of the intestine opposite to the attachment of the mesentery, and their direction is longitudinal in the gut. Usually they are from twenty to thirty in number. In the lower part of the ileum the patches are largest and most numerous; but they decrease in number and size upwards from that spot, till at the lower part of the jejunum they become irregular in form, and may consist only of small roundish masses.

Glands of Peyer; size; situation; number; peculiarities;

A patch, when examined with the microscope, appears to be only a collection of the solitary glands, for it consists of a number of small flattened vesicles or sacs, which are round or oval in form, and are covered by the mucous membrane. Like the glands referred to, the vesicles contain a whitish consistent fluid, and are commonly without any aperture, though they have been found with openings into the intestine. Around the vesicles is a circle of apertures of the crypts before described; and the mucous membrane over them is a little hollowed, and may in some instances be furnished with villi. Between the vesicles the lining membrane of the bowel has the same appearance as in other parts.

Composition of a gland same as that of the solitary glands.

Glands of Brunner.—Directions have been already given to expose these glands (p. 481). They are small compound glands, which exist only in the duodenum. Near the pylorus these bodies are visible without a lens, being nearly as large

Compound glands, or Brunner's;

composition. as hemp seed. When examined more minutely, the glands are found to consist of lobules, with appertaining little ducts; and each may be seen to end on the surface of the mucous membrane by a duct, whose aperture is slightly larger than the mouths of the contiguous crypts of Lieberkuehn.

Apertures of their ducts.

The epithelium is columnar. *Epithelium.*—The epithelial lining of the mucous membrane of the small intestine is of the columnar or cylindrical kind. For the villi it forms a very distinct covering of elongated or prismatic pieces; and it also sinks into the crypts of Lieberkuehn, giving them a lining.

How to see the cellular coat. *Dissection.*—To show the cellular membrane between the coats of the intestine, turn inside out a piece of the bowel, and inflate it forcibly. The air enters the wall of the intestine, where the peritoneal coat is wanting, and then spreads through the whole gut; but opposite the patches of Peyer's glands the mucous coat is more closely connected with the subjacent structures, and the cellular stratum will not be distended with the air. The intestine may be examined when it is dry.

Arteries; *Vessels and nerves of the intestine.*—The branches of *arteries* ramify in the submucous cellular layer, and end in small twigs that form a network in the mucous membrane to supply the valves, the villi, and the glands. Opposite the patches of Peyer's glands the intestine is most vascular. The *veins* have their usual resemblance to the companion arteries. The *absorbents* consist of a superficial longitudinal set (lymphatics), and of a deep transverse set (lacteals), which end in larger vessels in the mesentery. Beneath the patches of Peyer's glands the lymphatics form distinct plexuses.

veins; absorbents.

Two coats in the bile duct, *Structure of the bile duct.*—The bile duct consists of a strong fibrous coat, with an internal or mucous coat. Scattered over the surface of the mucous membrane are two sets of glands; one kind consists of small single cells collected together, and the others are branched tubes, which have often lateral dilatations.

and glands.

LARGE INTESTINE.

Extent of the gut; The large intestine is the part of the alimentary canal between the termination of the ileum and the anus. Its divisions, and the connection of these by peritoneum to the

abdominal wall have been described (pp. 450, 456). In length this part of the alimentary canal measures about five or six feet,—one fifth of the extent of the intestinal tube. The diameter of the colon is largest at the commencement in the cæcum, and gradually decreases from that part, so that it is somewhat less in the ascending colon, less in the transverse colon, and still less in the descending colon and the sigmoid flexure. In the rectum there is, however, a dilatation near the end. length; size;

When compared with the small intestine, the colon is found to be distinguished by the following characters:—it is of greater capacity, being in some parts as large again, and is more fixed in its position. The large intestine is also free from coils, except in the left iliac fossa, where it forms the sigmoid flexure. Instead of being a smooth cylindrical tube, the colon is sacculated, and is marked by three longitudinal muscular bands, which alternate with as many rows of dilatations or small sacs. Attached to the surface, at intervals, are processes of peritoneum, containing fat (appendices epiploïcæ), especially along the transverse colon. In the rectum, or the lower part of the large intestine, the surface is smooth, and the bands have disappeared. Compared with small gut, larger, more fixed, not coiled. Sacculated with bands. Appendages. In the rectum.

Dissection.—For the purpose of examining the large intestine the student should select and blow up the cæcum, with part of the ileum entering it; he should also prepare in a similar way a piece (about four inches) of the transverse colon, and a piece of the sigmoid flexure. Afterwards the cellular membrane is to be removed with care from each. Take pieces of the large intestine.

The CÆCUM, or the head of the colon (caput cæcum coli), is the rounded part of the large intestine which projects, in the form of a pouch, below its junction with the ileum. It measures about two inches and a half in length, and, though gradually narrowing inferiorly, the cæcum is the widest part of the colon,—hence the name caput coli. At its inner side it is joined by the small intestine; and still lower is seen a small worm-like projection—the vermiform appendix. Definition of cæcum; length and width; receives ileum and appendix.

Appendix vermiformis.—This little convoluted projection is attached to the lower and posterior part of the cæcum, of which it was the direct continuation at one period in the Vermiform appendix; attachment.

dimensions; growth of the embryo. From three to six inches in length the appendix is rather larger than a goose-quill, and is connected to the inner part of the cæcum by a fold of peritoneum. It is hollow. It is hollow, and has an aperture of communication with the intestine. In structure it resembles the rest of the colon.

Dry the cæcum, and open it to see the valves. *Dissection.*— To study the interior of the cæcum, and the valve between it and the small intestine, the cæcum should be dried, and the following cuts then made. An oval piece is to be taken from the end of the ileum, another from the side of the cæcum, opposite the entrance of the small intestine, and lastly the end of the colon included in the ligature is to be cut off.

Situation of the valve; two pieces form it; *Ileo-cæcal valve.*— On looking into the intestine, the ileo-cæcal valve will be seen at the entrance of the ileum into the cæcum. This structure is composed of two pieces, each with a different inclination, which project into the interior of the cæcum, and bound a narrow, nearly transverse aperture of communication between the two differently-sized parts of the alimentary canal. one ileo-colic, The upper piece of the valve (ileo-colic) projects vertically into the large intestine, opposite the junction of the ileum with the colon; the other ileo-cæcal. and the lower piece (ileo-cæcal), which is the larger of the two, has a horizontal direction between the ileum and the cæcum. These are joined at the ends, At each extremity of the opening the pieces of the valve are blended together, and the resulting folds extend transversely for some distance on the intestine, forming the *fræna* or *retinacula* of the valve. and form fræna. Opening in the valve. The size of the opening in the valve depends upon the distension of the intestine; for when the cæcum is enlarged, so as to stretch the *fræna*, the margins of the opening are approximated, and may be made to touch.

The valve a prolongation of the wall of the gut. Each piece of the valve is formed by the circular muscular fibres of the small and large intestine, covered by mucous membrane; as if the ileum was thrust obliquely through the wall of the cæcum, after being deprived of its peritoneal coat and of its layer of longitudinal fibres. The arrangement above referred to is easily seen on a fresh specimen by dividing the peritoneum and the longitudinal fibres, and then gently drawing out the ileum.

Appendix opens The *opening of the appendix* into the cæcum is placed

below that of the ileum. A small fold of mucous membrane partly closes the aperture, and acts as a valve. into cæcum.

Folds or *ridges* are also seen in the interior of the gut to be directed transversely, and to correspond to the depressions on the outer surface between the sacculi. These eminences result from the doubling of the wall of the intestine, and the largest enclose vessels and cellular membrane. Ridges in the cæcum; how formed.

STRUCTURE OF THE COLON.—The coats of the large intestine are the same in number and kind as in the small gut, viz. a serous, muscular, cellular, and mucous: their relative position to one another is also the same. Four strata in the wall of the gut.

1. *Serous coat.*—The peritoneum does not cover the large intestine in the same degree throughout. Commonly it covers only the front of the cæcum, and the front and sides of the ascending and descending colon; but in neither of these does it reach the posterior aspect. The transverse colon is incased like the stomach, and has an interval along both the anterior and the posterior border, at the attachment of the transverse meso-colon and great omentum. Serous coat differs along the intestine.

2. The *muscular coat* is formed by longitudinal and circular fibres, as in the small intestine, but the former are arranged in bands. Two layers of fibres;

a. The *longitudinal* set of fibres may be traced in the cæcum as a thin layer over the surface, but they are collected for the most part into three longitudinal bands about half an inch in width. On the vermiform appendix the longitudinal fibres form a uniform layer; but they are continued thence in the form of three bands along the cæcum and colon to the rectum, where they are again diffused over the surface. When the bands are divided the intestine becomes unfolded and elongated, the sacculi and the ridges in the interior of the gut disappearing at the same time. longitudinal in three bands, which are spread out on appendix and rectum,

b. The *circular fibres* are spread over the intestine, but are most marked in the folds or ridges that project into the intestine. In the rectum (to be afterwards seen) they also form the strong band of the internal sphincter muscle. and circular,

3. The *cellular coat* resembles that of the small intestine in every particular. It will be exposed by removing the peritoneal and muscular coverings. Cellular coat as in small gut.

This coat is without folds and villi.

4. The *mucous coat*, which will be seen on opening the intestine, is smooth, and of a palish yellow colour. It is not marked by folds except in the rectum, for the ridges in the interior of the gut are formed by all the coats. The surface is free from villi; and by this circumstance the mucous membrane of the large is distinguished from that of the small intestine. This line of demarcation is well seen in the ileocæcal valve; for the upper aspect which looks to the small intestine is covered with villi even to the edge of the opening, whilst the lower aspect which is covered by the lining membrane of the cæcum is free from these projections.

Structure very like that of small gut.

Microscopic appearances. In a fresh piece of intestine, the mucous membrane will be seen, under the microscope, to possess small tubes or crypts, some larger solitary follicles, and an epithelial covering.

Tubes or crypts more numerous than but like those of Lieberkuehn.

The *tubules* or crypts resemble those of the small intestine but are more numerous and closer together. Their orifices on the surface are circular, and are more uniformly diffused than the apertures of the crypts in the small intestine. A vertical section of the membrane will show the tubes to extend vertically from the surface into the cellular coat, and to be of greater length than the crypts of Lieberkuehn in the jejunum and ileum.

Simple glands most in the cæcum; size and form.

The *solitary follicles* are found all through the large intestine, scattered here and there; but they are in greatest number in the cæcum, and in the vermiform appendix. They are whitish rounded bodies from $\frac{1}{3}$ to $\frac{1}{2}$ a line in diameter, and are situate in the submucous cellular layer amongst the tubules. These follicular glands are simple sacs with a dilated cavity and a narrow neck opening into the intestine, being in form something like a small rounded fruit with a stalk.

Epithelium.

The *epithelium* is of the columnar kind, as it is in the small intestine, and enters the tubules and the follicles.

Vessels and nerves of the gut.

Vessels and nerves.—The distribution of the vessels and nerves in the wall of the large intestine is the same as in that of the smaller bowel. The absorbent vessels after leaving the wall join the lymphatic glands along the side of the colon.

THE PANCREAS.

The pancreas is a narrow flattened gland about seven inches in length, which has some resemblance to a dog's tongue. It is larger at the right than at the left end; and is divided into head, tail, and body. Form and length; divisions.

The *head*, or the right extremity, occupies the concavity of the duodenum, and projects above and below the body of the gland, like the head of a hammer beyond its handle; and the lower projecting piece is directed to the left along the duodenum as far as the superior mesenteric vessels, beneath which it passes. The left extremity, or the *tail*, is rounded, and touches the spleen. The *body* of the gland is narrowest a little to the right of the vertebral column, and is thickest at the upper border; it measures about one inch and a half in breadth, and from half an inch to an inch in thickness. Its connections with surrounding parts are described at p. 466. Situation and form of the head, of the tail, and of the body.

Dissection.—Place the pancreas on its anterior surface, and trace posteriorly, from right to left, the excretory duct contained in its substance. The duct will be recognised by its white colour. Trace out the duct.

Structure. — The pancreas is a compound gland, and is provided with a special duct. It is destitute of a distinct capsule, but it is surrounded by cellular tissue, which projects into the interior, and connects together the lobules. The fluid secreted by it assists in the digestion of the aliment. It is a compound gland, without a distinct capsule.

The glandular structure is soft and loose in texture, and is of a reddish, or greyish white colour. It consists of lobules, which are united into larger masses by cellular tissue, vessels, and ducts. In analysing a lobule it will be found to consist ultimately, as in the parotid, of the branchings of the excretory duct which end in closed vesicular extremities, and are surrounded by a plexus of vessels. Texture and colour; constitution like the salivary glands.

The *duct* of the pancreas (canal of Wirsung) extends the entire length of the gland, and is somewhat nearer the lower than the upper border. It begins in the tail of the pancreas, The duct of the gland; extent;

where it presents a bifurcated extremity; as it continues onwards to the head of the gland it receives many branches, and it finally ends by opening into the duodenum, either in union with, or separate from the common bile duct (p. 481.) Of the tributary branches the largest is derived from the head of the pancreas. The duct measures one line or one line and a half in diameter near the duodenum, and is formed of a fibrous and a mucous coat; in the latter a few follicles are sometimes found near the termination in the gut.

branches; termination; size and structure;

Occasionally there are two pancreatic ducts: or the branch from the head of the pancreas may open separately into the duodenum one inch or more from the chief duct.

peculiarities;

Vessels and nerves.—The arteries and veins have been described already. The lymphatics join the lumbar glands, and the nerves are furnished by the solar plexus.

Vessels and nerves.

THE SPLEEN.

The spleen is a vascular spongy organ of a bluish or purple colour, sometimes approaching to gray; and of slight consistence, so that the texture is friable, and easily broken under pressure. The use of the spleen is unknown.

Consistence and colour of the spleen; use;

The viscus is somewhat elliptical in shape, and is placed vertically against the great end of the stomach, as before described (p. 452.). On the outer aspect the surface is convex towards the ribs. On the inner aspect the surface is flat or slightly concave, and is marked by a longitudinal fissure or *hilus*, nearer the posterior than the anterior border, which transmits the vessels into the interior; to this surface the gastro-splenic omentum is connected, and with it the tail of the pancreas is in contact. The anterior border is thinner than the posterior, and is often notched. Of the two extremities, the lower is more pointed than the upper.

form; position; surfaces; borders; ends.

The size of the spleen varies much at different times. In the adult it measures commonly about five inches in length, three or four inches in breadth, and one or one inch and a half in thickness. Its weight lies between four and ten ounces, but is rather less in the female than in the male.

Size and weight.

Small masses or *accessory spleens* (splenculi) are often found near the fissure of the spleen, in the gastro-splenic omentum, or in the great omentum. Varying in size from a bean to a moderate sized plum, these bodies are commonly one or two in number; but they may be many more. In one instance they exceeded even a score. Sometimes accessory spleens.

STRUCTURE. — Enveloping the spleen are two coverings, a serous and a fibro-elastic. The mass of the spleen is formed by a network of fibrous tissue, which contains in its meshes the proper splenic substance, the ramifications of the bloodvessels, and the Malpighian corpuscles. No duct exists in connection with this organ. Two coats and special material in the spleen.

1. The *serous* or *peritoneal coat* incases the spleen, covering the surface, except at the hilus and posterior border. It is closely connected to the subjacent coat. Serous coat nearly complete.

2. The *fibro-elastic coat* gives strength to the viscus, and forms a complete case for it. At the fissure on the inner surface, this investment enters the interior of the spleen with the vessels to which it furnishes sheaths. If an attempt is made to detach this coat, numerous fibrous processes will be seen to be connected with the inner surface. Its colour is whitish; and its structure is made up of areolar and elastic tissue with, in certain animals, some unstriped muscular fibres, like those of the middle coat of an artery. — Professors Sharpey and Kölliker. — Quain's *Anatomy*. Fibrous coat sends inwards processes. Fibres that form it.

On cutting across the spleen the surface is reddish brown, with interspersed white bands. By washing and squeezing a piece of fresh bullock's spleen under water, so as to remove the grumous material, its spongy structure will come into view. Interior of spleen,

The fibro-elastic tissue of the interior of the spleen is continuous at the hilus with that forming the outside coat. Near the hilus the tissue forms thick bands that surround the vessels, and incase their branches. Farther in the substance of the spleen smaller bands (trabeculæ) are given off in all directions from those sheaths of the vessels, which divide and subdivide so as to form a network of fibres through the whole mass of the spleen. In the interstices between the and disposition of fibrous tissue in it. To form ane arolar structure.

fibres the proper red pulpy substance of the spleen and the vessels are contained.

Parts seen with microscope.

Microscopic appearances.—The characters of the substance of the spleen, and of the Malpighian bodies must be made out with the aid of the microscope.

Splenic substance; colour, consistence and size.

a. The *proper substance* of the spleen is a soft semi-fluid red-brown mass, which fills the areolæ of the trabecular structure. Under the microscope this material is composed of rounded, reddish corpuscles, about the size of those of the blood.

Malpighian bodies; size; groups; attachment; constituents; their vessels.

b. The *Malpighian corpuscles* are found only in the recent condition of the part; they are small vesicular bodies, varying in diameter from $\frac{1}{25}$th to $\frac{1}{60}$th of an inch. Collected together in groups of six or eight, these bodies are embedded in the splenic substance near the smallest bands of fibrous tissue, and are supported by a small arterial branch that serves as a pedicle to them. Their wall is formed of two coats, the external being apparently fibrous; and in the interior is a white soft material which contains globules resembling those of the chyle. The arteries that extend to the vesicles do not enter the interior, but form around them a vascular layer.

Splenic artery supplies corpuscles of spleen. Vein begins by plexuses.

Blood-vessels.—The branches of the *splenic artery* enter the spleen, and are surrounded by sheaths of the elastic tissue. In this viscus they ramify until the branches become very minute, and are contained in the small fibrous bands. Lastly, terminal twigs leave the trabeculæ, and entering the areolæ, end in tufts amongst the corpuscles of the splenic substance. The *splenic vein* begins in the interstices between the trabeculæ, where its branches form a plexus; but its commencement with respect to the arteries is unknown. At the same part they also present lateral dilatations. The branches of veins are much larger than the arteries which they accompany to the fissure of the spleen, and in their course they receive accessory branches, some joining at a right angle.

Lymphatics. Nerves.

Nerves and lymphatics.—The *lymphatics* are superficial and deep, and enter the glands in the gastro-splenic omentum; the *nerves* come from the solar plexus, and surround the artery and its branches.

THE LIVER.

The liver secretes the bile, and is the largest gland in the body. Its duct opens into the duodenum with that of the pancreas. Office of the liver.

Dissection.—Preparatory to examining the liver, place uppermost its under surface, and remove the peritoneum and cellular membrane from the vessels and from the hepatic duct. To make the dissection easier inflate the vena portæ, and the gall bladder through its duct; clean then the gall bladder. On following outwards the left branch of the vena portæ to the longitudinal or antero-posterior fissure, it will be found connected anteriorly with the remains of the umbilical vein, and posteriorly with the remains of the ductus venosus. Clean the vessels on the under surface.

The liver is the largest of the abdominal viscera, and weighs commonly in the adult from three to four pounds (fifty to sixty ounces). It is of a red-brown colour and firm consistence. Transversely the gland measures from ten to twelve inches; from front to back between six and seven inches; and in thickness, at the right end, about three inches, but this last measurement must change with the spot examined. Size, colour, and consistence; measurements.

In shape the liver is somewhat square, and offers for examination externally two surfaces, two borders, and two extremities, with several lobes, fissures, and vessels. The ligaments and the connections of the liver are described at pp. 451, 457. Form and divisions.

Surfaces.—On the upper aspect the liver is convex. Extending from front to back is the suspensory ligament, which divides the upper surface into two unequal parts, the right being the larger. The under surface is irregular, and is marked by lobes, fissures, and fossæ. In contact with this surface is the gall-bladder. A fissure divides the under surface into a right and a left lobe. Upper surface smooth; under surface irregular.

Borders.—The anterior border is thin, and is marked by two notches: one is opposite the fissure on the under surface before alluded to, and the other corresponds to the edge of the gall-bladder. The posterior border is much thicker at the right end than at the left, and in that part it is con- Anterior border is thin and notched, posterior is thicker,

and also notched. nected by cellular tissue to the diaphragm. Opposite the vertebral column is a hollow in this border. The vena cava is partly imbedded in the substance of the liver on the right of that spot.

Extremities. *Extremities.*—The right part of the liver is thick and rounded, but the left is thin and flattened.

Lobes are on under surface, and are five, viz. *Lobes.*—On the under surface the liver is divided into a right and a left lobe, by the fissure (longitudinal) that passes from before backwards; and the right lobe is further subdivided inferiorly into three others, viz. the square lobe, the Spigelian lobe, and the caudate lobe.

left, The left lobe is smaller and thinner than the right, and has a slight depression inferiorly where it touches the stomach.

right; last subdivided into The right lobe forms the greater part of the liver, and is separated from the left lobe by the longitudinal fissure on the one aspect, and by the suspensory ligament on the other. To it the gall-bladder is attached; and the following lobes are projections on its under surface.

square, The square lobe (lobulus quadratus) is situate between the gall bladder and the longitudinal fissure. It reaches anteriorly to the margin of the liver, and posteriorly to the fissure (transverse) by which the vessels enter the interior of the organ.

Spigelian, The Spigelian lobe lies behind the transverse fissure, and forms a roundish projection on the surface. On its left side is the longitudinal fissure, and on its right the vena cava inferior.

and caudate lobe. The caudate lobe is a slight elongated eminence that is directed from the Spigelian lobe behind the transverse fissure, so as to form the posterior boundary. Where the fissure terminates, this projection subsides in the right lobe.

Three fissures, viz. portal, or transverse, *Fissures.*—Extending horizontally half across the right lobe, between the Spigelian and caudate lobes on the one hand, and the square lobe on the other, is the *transverse* or *portal fissure.* This fissure or *hilus* is nearer the posterior than the anterior border of the liver, and contains the vessels, nerves, ducts, and lymphatics of the viscus. At its left end it is united with the longitudinal fissure at a right angle.

The *longitudinal fissure* extends from the front to the back of the liver between the right and left lobes. In the part anterior to the transverse fissure (umbilical fissure) is the remains of the umbilical vein, which is called round ligament, and is oftentimes arched over by some of the hepatic substance (pons hepatis). In the part behind the transverse fissure (fissure of the ductus venosus) is a small obliterated cord that remains from the ductus venosus of the fetus. The *fissure* or *groove* for the *vena cava* is placed on the right side of the Spigelian lobe, and is frequently bridged over by the liver. If the cava is opened, the large hepatic veins will be seen entering it.

longitudinal;

one for the vena cava.

Fossæ.— On the under surface of the right lobe are these depressions: one for the gall-bladder, to the right of the square lobe; another for the colon, near the anterior part; and a third for the kidney, near the posterior part.

Vessels of the fissures.—The vessels lying in the transverse fissure, viz. vena portæ, hepatic artery, and duct, have the following disposition: — the duct is most anterior, the portal vein most posterior, and the artery between the other two. *Hepatic duct.*—The duct that conveys away the bile is formed by two branches that issue from the liver, one from each lobe, and are soon blended in a common tube or hepatic duct. After a distance of two inches, the hepatic duct is joined by the duct of the gall-bladder; the union of the two giving rise to the common bile-duct. The *hepatic artery* is divided into two, for the right and left lobes, and its branches are surrounded by nerves and lymphatics. The *vena portæ* branches, like the artery, into two trunks, for the same lobes, and gives also an offset to the Spigelian lobe. Its left branch is the longest.

Vessels in the transverse fissure;

situation and branching.

In the longitudinal fissure are the remains of former vessels which have the undermentioned arrangement in the fœtus. Before birth the large umbilical vein occupies the longitudinal fissure, and opens posteriorly into the vena cava; but the part of the vessel beyond the transverse fissure receives the name ductus venosus. Branches are supplied from it to both lobes of the liver, and a large one that is directed to the right lobe is continuous with the left division of the vena portæ. After birth the umbilical

In the longitudinal fissure in the fœtus,

Condition after birth. vein is closed, and becomes eventually the round ligament; the ductus venosus is also obliterated, only a thin cord remaining in its place, whilst the lateral branches in a line with those of the vena portæ remain open, and form part of the portal system of vessels. Occasionally the ductus venosus is found pervious in part.

Glandular structure is encased by two coats. STRUCTURE OF THE LIVER.—Two coats envelop the liver, viz. a serous and a cellular. The substance of the liver consists of a collection of small secreting bodies, called lobules or acini; together with a large proportion of vessels, which are concerned both in the production of its secretion and in the nutrition of the organ.

Serous coat, where deficient. 1. *Serous coat.*—The peritoneum invests the liver in great part, and adheres closely to the subjacent coat. At certain spots, intervals exist between the two, viz. in the fissures occupied by vessels, at the lines of attachment of the ligaments, and on the surface covered by the gall-bladder. Where the right lateral ligament is inserted the space is the largest; and here the liver is fixed to the diaphragm by cellular membrane.

Fibrous covering is prolonged to the interior. 2. The cellular or *fibrous* covering is very thin, but it is rather stronger where the peritoneum is not in contact with it. It invests the liver, and is continuous, at the transverse fissure, with the fibrous sheath (capsule of Glisson) that surrounds the vessels in the interior of the hepatic mass. When the membrane is torn from the surface, it is found to have fine prolongations, that dip between the lobules or glandular structure of the liver.

Lobules of the liver; size and appearance; form and cellular investment. *Lobules.*—The lobules constitute the proper hepatic substance, and can be seen on the exterior of the liver, on a cut surface, or by means of a rent of the mass. As thus observed, these bodies are about the size of a pin's head, and measure from half a line to a line in diameter. Closely massed together, each presents a dark central point, and is isolated from the surrounding ones by a cellular stratum. By means of transverse and vertical sections of the lobules, their form will appear triangular on the exterior, but five or many sided in the interior of the liver. They are clustered around the smallest divisions (sublobular) of the hepatic vein, to which each is connected by a small twig issuing from the

centre (intra-lobular vein), something like the lamina with the stalk or petiole of a leaf. The part of each lobule in contact with the small sublobular vein wants the cellular covering that invests the other sides.

Difficult to study lobules.

To study the minute structure of these ultimate elements of the hepatic substance, the student should have the different vessels of the liver minutely injected, and be provided with a microscope.

A lobule is a distinct gland.

Each lobule or elementary piece of the liver may be said to be a distinct gland, for it is provided with special secretory vessels and with an excretory duct. Minute injections show the lobules to be composed of a network of capillaries of the vena portæ, hepatic vein, and biliary duct, with constituent cellular membrane.

Arrangement of its vessels, viz.: vena portæ, hepatic vein, and bile duct,

The disposition of these several vessels is the following: The smallest branches of the vena portæ (interlobular), after uniting in a circle around the lobule, enter its substance, and form therein a network of capillaries near the circumference. The hepatic vein occupies the centre of the lobule, and its radicles communicate with the portal plexus; it issues from the base of the lobule as the intralobular vein. The ultimate ramifications of the bile duct (lobular biliary plexus) are situate in the intervals of the network of the portal plexus; and connected with these are some secretory or biliary cells that take part in the production of the bile: the roots of the bile duct leave the lobule at its circumference, and are joined in a plexus (interlobular) outside it, like the portal vessels. From the facts above stated respecting the arrangement of the vessels, it appears that the portal capillaries convey the blood from which bile is secreted; that the hepatic vein carries back the remaining blood; and that the secreted bile is conveyed away by the branches of the biliary duct.

Use of the vessels,

Biliary cells of the lobule.

Situation and form;

size and contents;

connection with ducts.

Forming a part of the lobule are some *hepatic* or *biliary* cells, which extend from the centre to the circumference in the form of rows of particles, and are situate in the intervascular spaces. Under the microscope they have an irregular form, being roundish, elongated, or many sided; and they possess a bright nucleus, or even more than one. In size they vary from $\frac{1}{1050}$ to $\frac{1}{840}$th of an inch; they are of a yellowish colour, and enclose certain granules and fat globules besides a nucleus. These nucleated cells are connected with the origin of the ducts, and are concerned in the secretion of the bile; but the origin of the ducts within the lobule,

and the disposition of the cells have not been ascertained with exactness.

Arrangement of vessels in the liver.

VESSELS OF THE LIVER.—Two sets of vessels ramify in the liver: one set, concerned in the secretion and the nutrition of the organ, enter the transverse fissure, and are directed transversely in spaces (portal canals), where they are enveloped by cellular tissue; the other set, or the hepatic veins, run from the anterior to the posterior border of the liver, and convey to the vena cava the blood that has been circulated through the organ. The ramifications of these different vessels are to be traced in the liver.

Vena portæ occupies portal canals, and supplies vaginal and interlobular branches.

The *vena portæ* ramifies in the liver like an artery, and the blood is circulated through it in the same manner, viz. from trunk to branches. After entering the transverse fissure the vein divides into primary branches that lie in the portal canals or spaces with offsets of the hepatic artery, of the hepatic duct, and of the nerves and lymphatics. The same division is repeated again and again, and the resulting vessels give off minute lateral branches, some of which, *vaginal*, ramify in the cellular sheath before their final distribution to the hepatic substance, whilst others from the smaller divisions pass to the lobules without previous anastomosis. Finally, the last branches of the vein penetrate between the lobules, around which they form a circle, and then end in the interior as before explained: where these twigs lie between the lobules they are named *interlobular*.

Bile duct.

The *hepatic duct* begins in the lobules, and its branches form a plexus, *interlobular*, between them. The smallest ducts soon unite into larger *vaginal* branches that lie in the portal canals with the other vessels. Lastly, the ducts are collected into a right and a left trunk, which leave the liver at the transverse fissure as before described.

Some ducts in the lateral ligament.

In the left lateral ligament of the liver ducts are sometimes found between the layers of the peritoneum; they anastomose together and are accompanied by branches of the vessels of the liver, viz. vena portæ, hepatic artery, and hepatic vein.

Hepatic artery nourishes the liver, and joins vena portæ.

The hepatic *artery* is consumed in the nutrition of the structure of the liver. Whilst surrounded by the capsule of Glisson it furnishes *vaginal* branches which ramify in that sheath, giving it a red appearance in a well injected liver; and other twigs enter the coats of the vena portæ and biliary duct. From the vaginal

branches there are some few offsets sent between the lobules to supply their structure. This artery is supposed by Mr. Kiernan to terminate in venous capillaries that communicate with the branches of the vena portæ.

The *capsule of Glisson* is a layer of fibro-cellular structure that envelops the vessels entering the liver through the transverse fissure. In this sheath the vessels ramify, and in it they are minutely divided before their final termination in the lobules. Processes of the sheath accompany the small interlobular vessels, and join the cellular covering of the lobules. If a transverse section is made of a portal canal, the vessels will retract somewhat into the loose surrounding tissue.

Preceding vessels contained in a cellular sheath that extends to the lobules.

The *hepatic veins* (venæ cavæ hepaticæ) begin by a plexus in the interior of each lobule. Issuing from the base of the lobules as the *intralobular* veins, they end in still larger or *sublobular* branches. The next sized branches cease to receive any intralobular twigs, and merely unite with neighbouring branches to produce larger veins. Finally the hepatic veins are collected into large trunks that are directed from before backwards to the vena cava inferior, into which they open by large orifices. The venæ cavæ hepaticæ may be said to be without a cellular sheath, for it is very slight only in the larger trunks; consequently when they are cut across the ends remain patent by reason of their close connection with the hepatic structure.

Hepatic veins without a sheath begin in the lobules, and end in the vena cava.

THE GALL-BLADDER.

The gall-bladder is the receptacle of the bile, and is situate in a depression on the under surface of the right lobe of the liver, to the right of the square lobe. Conical in form, or pear-shaped, its larger end (*fundus*) is directed forwards beyond the margin of the liver; whilst the smaller end, or the neck, is turned in the opposite direction, and bends downwards to end in the cystic duct by a zigzag part. In length the gall-bladder measures three or four inches, and in breadth rather more than an inch at the fundus, or the widest part. It holds rather more than an ounce. By one surface the sac is in contact with the liver, and on the opposite it is covered by peritoneum. The larger end touches the abdominal wall opposite the tip of the cartilage of the tenth rib,

Use and situation; form; size; connections;

and is contiguous to the transverse colon; and the small end touches the duodenum.

Structure of wall. *Structure.*—The wall of the gall-bladder has a peritoneal, a fibrous, and a mucous coat, with thin intervening cellular layers.

Serous coat. 1. The *serous* coat is stretched over the under or free aspect of the gall-bladder, and surrounds the large end when the viscus is distended.

Fibrous stratum sometimes muscular. 2. The *fibrous* coat, which has not much strength, gives a complete covering to the sac, and is formed by the intermixture of white shining fibres. Unstriped muscular fibres have been recognised in this coat in the gall-bladder of the ox.

Mucous layer is areolar on surface, 3. The *mucous* coat is marked internally by numerous ridges and intervening depressions, which give an areolar or honeycomb appearance to the surface. On laying open the gall-bladder, this condition will be seen, with the aid of a lens, to be most developed about the centre of the sac, and to diminish towards each extremity. In the larger hollows and covered by a columnar epithelium. there are other smaller depressions, which lead to mucous follicles. The surface of the mucous membrane is covered by a columnar epithelium.

Projections of the wall. Where the gall-bladder is bent, at its junction with the cystic duct, its coats project into the interior, and give rise to ridges that resemble the parietal septa in the sacculated large intestine.

Duct of gall-bladder. The *cystic duct* joins the hepatic duct at an acute angle, to form the ductus communis choledochus. It is about an inch and a half long, and is distended and somewhat sacculated near the gall-bladder.

Structure same as sac, *Structure.*—The coats of the duct are the same as those of the sac from which it leads. On slitting open the duct the mucous membrane is seen to form a series of semilunar projections (from mucous coat like a screw, nine to twenty), which are arranged obliquely around the tube like the thread of a screw, and increase in size towards the gall-bladder. This structure is best seen on a gall-bladder inflated and dried; in and is provided with glands, which state the parts of the bladder between the folds are most distended, giving rise to the sacculated appearance. The mucous lining is provided with glands, as in the hepatic and common bile

ducts (p. 484.). In the hepatic duct the glands are arranged in a row on each side.

Blood-vessels and nerves. — The vessels of the gall-bladder are named cystic; the *artery* is a branch of the hepatic, and the vein opens into the vena portæ near the liver. The *nerves* are derived from the hepatic plexus, and entwine around the artery. The *lymphatics* follow the cystic duct, and join the deep lymphatics on the spinal column. Artery, and vein, nerves, and lymphatics.

THE KIDNEY AND URETER.

The organ for the secretion of urine has a characteristic form, and serves as a type of comparison with other bodies. Flattened on the sides, it is larger at the upper than at the lower extremity, and is hollowed out at the inner part of its circumference. For the purpose of distinguishing between the right and left kidneys, let the excavated margin be supposed to be turned to the spinal column, the ureter, or the excretory tube, being kept more posterior than the several vessels, and let that end be directed downwards towards which the ureter is naturally inclined. Use and form. To distinguish right from left.

With the general form above mentioned, the kidney is of a deep red colour, and presents an even surface. Its average length is about four inches, its breadth two inches, and its thickness about one inch; but the left is commonly longer and more slender than the right kidney. The usual weight of this body is about four ounces and a half in the male, and rather less in the female. Colour, size, and weight.

At its upper extremity the kidney is rounded, is thicker than at the lower part, and is surmounted by the supra-renal body, whilst the lower end is flat and more pointed. The relative position with respect to the spinal column has been before detailed (p. 452). On its anterior aspect the kidney is convex, but on the opposite surface it is flattened. The outer border is convex; but the inner is excavated, and is marked by a longitudinal fissure (*hilum*), which contains the vessels, nerves, and excretory duct of the kidney. Extremities; surfaces; borders.

In the fissure of the kidney the several vessels are thus placed with respect to one another: — The divisions of the Contents of the fissure;

their position. renal vein are in front, the ureter behind, and the branches of the artery between the other two. On the vessels the nerves and lymphatics ramify, and cellular structure surrounds the whole.

Open the kidney, and clean vessels. *Dissection.* — To examine the interior of the kidney it will be necessary to cut it through from the outer to the inner border, and to remove the loose cellular membrane from the vessels, and from the divisions of the excretory duct that enter the hilum. The hollow that now comes into view, and contains the blood-vessels, is called *sinus* of the kidney.

Secretory tubes are incased by a fibrous coat. STRUCTURE OF THE KIDNEY. — The substance of the kidney consists of a mass of minute secretory tubes, intermixed with blood-vessels, lymphatics, nerves, and fine cellular tissue: and the whole is encased by a fibrous coat.

Fibrous coat sends in offsets. The *fibrous coat* is a white firm case, which is connected with the renal tissue by fine processes and vessels, but is readily detached therefrom by slight force. At the inner margin of the kidney, it sinks into the hollow or sinus, and sends processes on the entering vessels: at the same spot it is continuous with the fibrous coat of the excretory duct.

Renal substance divided into cortical and pyramidal. The *interior of the kidney* appears on a section to consist of two different materials, viz. of an external granular or cortical part; and of internal, darker coloured, pyramidal masses, that converge towards the centre, and are connected with the divisions of the excretory duct. But it will subsequently appear that each of these parts is constructed of the same elements somewhat differently arranged.

Extent of cortical substance; The *cortical substance*, or the external part, forms about three-fourths of the kidney; it covers the pyramidal masses with a layer about two lines in thickness, and sends prolongations between the same nearly to their extremities. colour; Its colour is of a light red, unless the kidney is blanched, consistence; composition. and its consistence is so slight that the mass gives way beneath the finger. This layer is formed of a congeries of minute convoluted uriniferal tubes, surrounded by vascular plexuses; and in a well-injected specimen red points (Malpighian bodies) are seen scattered here and there through its texture.

Pyramids, The *pyramidal masses* (pyramids of Malpighi, medullary

substance,) are twelve or eighteen in number, and converge to the sinus of the kidney. Each mass is conical in form, with its base turned towards the circumference of the organ, and surrounded by the cortical substance; and with its apex, which is free from cortical covering, directed to the hollow at the inner part of the kidney. At this last spot it ends in a smooth, rounded part, named *mamilla* or *papilla*, which is surrounded by one of the divisions (calyx) of the excretory tube. Occasionally two of the masses are united in one papillary termination. This part of the kidney is denser than the cortex, its colour is darker, and its cut surface has a grooved appearance. The conically-shaped mass is constructed of a bundle of the uriniferal tubes, which have become straight, and are converging to their termination on the papilla. If the mass is compressed, urine will exude from the tubes through apertures in the apex.

number, form, and direction; end in papillæ. Physical characters; composition.

In the human fœtus, and in some animals, the kidney is divided into separate lobes, to which a pyramidal mass, with its cortical envelope, corresponds in the adult. With the growth of the human kidney the original divisions disappear, and the cortical covering of contiguous lobes is blended to produce the interlobular cortical part. In the fully developed kidney the uriniferous tubes and the vessels of each pyramid and its envelope are distinct as in the organ in its lobular condition.

Rudimentary condition of the kidney.

To obtain a knowledge of the anatomy of the secreting tubes, and to make out the disposition of the blood-vessels, the dissector will require a microscope and good fine injections of the part.

How the kidney is to be studied.

The *uriniferous tubes* (tubuli uriniferi) are the ramified terminations of the excretory duct, which pour out the urine. In the cortex of the kidney, where the tubes present closed extremities, they are innumerable, are very convoluted, and of different sizes (tubes of Ferrein), though they average about $\frac{1}{500}$th of an inch. In this part they are closely surrounded by a plexus of blood-vessels, and are usually distinct one from another. A certain number of the tubes converge towards each pyramid (which they form), and having become straight, are directed downwards to the apex of that body, where they open by somewhat dilated orifices. In the pyra-

Uriniferous tubes; Character in cortex of kidney; convoluted, surrounded by vessels; in pyramid straight, fewer in

number and vessels; have open mouths inferiorly.

mid the tubes lie close together, and have but few vessels between them; they further diminish in number, from base to apex, by repeated unions, and are enveloped by the parenchymatous structure of the kidney. On a section of one of the pyramids, near the lower end, Krause estimated the number of tubes at a hundred in a square line.

Structure of the wall of a tubule; basement membrane and epithelium.

The tubes consist of a thin basement membrane, lined by an epithelium of the spheroidal form, which forms three-fourths of the thickness of the wall, except in the pyramid, where it is thinner, and the cells smaller and flatter. At its free extremity each tube presents a dilated or saccular part, which contains a small vascular Malpighian body, and it is there perforated by the two vessels connected with that body.* Into this little sac the epithelial lining does not extend, for it ceases at the neck, becoming very delicate and translucent.

Nature and quantity uncertain.

Intermediate substance of the kidney. — Between the uriniferal tubes there is a small quantity of a parenchymatous material whose nature has not been agreed on. By some it is described as cellular, by others as fibrous.

Blood vessels are large, and arteries are peculiar.

Blood-vessels.—The artery and vein that are distributed to the kidney are very large in proportion to the size of the organ they nourish. Moreover, some small arterial branches have a pecular disposition in the Malpighian bodies before they become capillary, and end in the veins.

Branches of the artery reach exterior, supply tubules, and form glomeruli;

Renal artery. — As the artery enters the kidney it divides into four or five branches, which are invested by sheaths of the fibrous capsule, and are transmitted to the cortical substance between the pyramidal masses. Some of the offsets of a chief branch enter the pyramidal mass, and ramify on the tubes, forming anastomotic loops parallel with those tubes, whilst the continuation of the trunk is distributed in the cortex around the pyramid. The terminal twigs of the artery end either in the Malpighian bodies or in a vascular plexus around the uriniferal tubes.

these are in the tubules.

The *Malpighian corpuscles* (glomeruli of Ruysch) are small, rounded or oblong, vascular bodies, that are contained in the

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* See a Paper in the Philosophical Transactions for 1842, Part. I., On the Structure and Use of the Malpighian Bodies of the Kidney, by W. Bowman, F.R.S.

dilated extremities of the uriniferal tubes. Each little vascular tuft has commonly a diameter of $\frac{1}{120}$th of an inch, and is formed by the capillary ramifications of two small vessels that perforate the end of the containing tube. One vessel (afferent) is a small twig of the renal artery, which forms the exterior of the tuft by its branchings; the other (efferent) begins in the centre of the tuft, and issuing from the tube ends in the plexus on a neighbouring uriniferal tube. This capillary body is free in the cavity of the tube that secretes the urine, but it is covered by some nucleated scales. Size; composed of two vessels.

Renal vein. — This vein begins in the capillary plexuses on the convoluted urine tubes, and its larger branches are directed to the centre of the kidney, where they communicate around the pyramidal masses. From this spot the divisions of the vein accompany those of the artery, and are united finally into one trunk that opens into the vena cava. Some of the small roots of the vein may be seen to form an arborescent appearance on the surface of the kidney. Veins begin around tubules, and end in vena cava.

The URETER is the tube by which the fluid secreted in the kidney is conveyed to the bladder. Its anatomy must be studied when the body is in a suitable position. Between its origin and termination this duct measures from sixteen to eighteen inches in length. Its size corresponds commonly to that of a large quill, but near the kidney it is dilated into a funnel-shaped part, named *pelvis*, and near the bladder it is again somewhat dilated, though its aperture of termination is the narrowest part of the tube. Ureter; office; length. Size varies.

In its course from one viscus to another, the ureter is close beneath the peritoneum, and is directed obliquely downwards and inwards along the posterior wall of the abdomen as far as the pelvis, where it becomes almost horizontal in direction in the posterior false ligament of the bladder. At first the ureter is placed over the psoas muscle, inclining on the right side towards the inferior vena cava, and then on the common or on the external iliac artery*, being situate between the vessel and the sigmoid flexure on the left side, and between Course and connections.

* In a dozen uninjected bodies that were examined for me by S. F. Statham, Esq., the ureter was found as frequently over the one as the other of the two vessels mentioned.

it and the end of the ileum on the right side; and, lastly, in the posterior ligament of the bladder it will be subsequently seen to lie below the level of the obliterated hypogastric artery. About the middle of the psoas this excretory tube is crossed by the spermatic vessels. Sometimes the ureter is found divided into two for a certain distance.

Sometimes double.

Ureter has calices,

Part in the kidney.—When the ureter is traced upwards into the kidney, it is found to begin by a set of cup-shaped tubes, named *calices*, which vary in number from seven to thirteen. Each cup-shaped part embraces the rounded end of a pyramidal mass, and receives the urine that flows through the apertures in that projection. The several calices are united together to form two or three larger tubes; and these are finally blended in the excretory duct or the ureter, which is dilated into a pouch, *pelvis*, in the hilum of the kidney. Sometimes a calix surrounds two or three papillæ.

which embrace pyramids,

and is dilated near the kidney.

Two coats in ureter,

fibrous and muscular;

mucous.

Structure.—On cutting open the ureter, both longitudinally and across, its walls will be found to consist of an external or fibrous and an internal or mucous coat. The *fibrous* covering forms a dense bluish-white layer, which is composed of bundles of areolar tissue, and of unstriped muscular fibres. The *mucous* coat is thrown into longitudinal folds during the contracted state of the ureter, and is lined by an epithelium of the spheroidal form. The *calices* resemble the rest of the duct in having a fibrous and a mucous coat. Around the pyramid the fibrous tissue is continuous with that of the enveloping tunic of the kidney where this projects inwards; and at the apex of that body, the mucous lining is prolonged into the uriniferal tubes through the small openings of the papilla.

The calices also two coats.

THE SUPRA-RENAL CAPSULE.

Use unknown.

No duct.

This small body, whose use is unknown, has received its name from its position in the abdomen. Its vessels are numerous, but it is not provided with any excretory duct.

Situation,

colour,

In form, the supra-renal capsule resembles a cocked hat, and it is situate, one on each side, on the front of the upper extremity of the kidney. It is of a yellowish colour, and without care it may be removed with the surrounding fat,

which it resembles. The upper part is convex, but the base or lower part is hollowed where it touches the kidney. Its size in the adult is about one inch and a half in depth, and one inch and a quarter in width, and its weight is about one drachm and a half; but the left is commonly larger than the right capsule.

form, size and weight.

Some cellular tissue attaches the supra-renal body to the kidney, and large vessels and nerves retain it in situation. The connections with the surrounding parts are the same as those of the upper end of the kidney. Thus this body rests on the diaphragm on both sides, whilst above the right one is the liver, and above the left the spleen. On the inner side of the right capsule is the vena cava, with part of the solar plexus, and internal to the left is the aorta, with the same plexus of nerves.

Connections.

Structure.—By means of a perpendicular section, the supra-renal body will be seen to be formed of a firm external or cortical part, and of an internal soft and dark material. The whole is surrounded by a thin fibrous capsule, that sends processes into the interior and along the blood-vessels. With the aid of a microscope, the nature of the two materials above noticed will be found to be as below:—

A capsule surrounds two different structures, viz.—

The *cortical* part is yellow in colour and striated, and its ultimate structure consists, according to Mr. Simon, of very small separate closed tubes, about $\frac{1}{700}$th of an inch in diameter, which are arranged vertically, in masses, around the central part, and surrounded by blood-vessels. In these fine microscopic tubes there are contained bodies like nuclei, together with nucleated granular cells, granules, and particles of oil.

a cortical, which consists of tubules,

The *central* soft part is of a black or dark brown hue, and is formed chiefly of a plexus of minute veins. In the interior of the mass there is sometimes a venous space.

and a central vascular part.

Blood-vessels.—Numerous branches of *arteries* are furnished to the supra-renal body from the diaphragmatic and renal arteries, and from the aorta. In the interior of this body the arteries end in capillary plexuses that surround the small tubes above described. The *veins* originate in the plexuses on the tubes, and the several

Arteries.

Veins.

branches are collected into a trunk that opens on the right side into the vena cava, and on the left, into the renal vein.

THE TESTES.

Situation in the scrotum and enveloped by a serous sac.

The testes are two glandular organs for the secretion of the semen, and are lodged in the scrotum. Each is suspended by the spermatic cord, and its coverings (p. 431), the left being usually lower than the right, and each is provided with an excretory duct named vas deferens. A serous sac partly surrounds each organ.

To see the serous sac.

Dissection. — For the purpose of examining the serous covering of the testicle (tunica vaginalis), make an aperture into it and inflate it. Then clean the surface both of the sac and of the spermatic cord, and follow the vessels of the latter to their entrance into the testicle.

Serous bag

partly covers the testicle,

and lines scrotum;

The *tunica vaginalis* is a serous bag, which is continuous with the peritoneal lining of the abdomen in the fetus, but becomes a distinct sac in the adult, in consequence of the obliteration of the tube connecting the two. It invests the testicle after the manner of other serous membranes on their respective viscera; for the testicle is placed behind it, so as to be partly enveloped by it, and yet not in the enclosed cavity. The sac, however, is larger than is necessary for covering the testicle, and projects some distance above that viscus. Like other serous membranes, it has an external rough, and an internal secerning smooth surface; and like them it has a visceral and a parietal part. To examine its disposition the sac should be opened.

its visceral part

The visceral layer (tunica vagin. testis) covers the testicle, except posteriorly, where the vessels enter or leave it, and is inseparably united with the special fibrous coat of that viscus. On the outer side it extends farther back than on the inner, and it passes between the testis and the arched body (epididymis) that lies on this aspect of the organ.

and parietal.

The parietal part of the sac (tunic. vag. scroti) is more extensive than the piece covering the testicle, and lines the immediately contiguous layer of the scrotum.

Form and position of the testis.—The testicle is oval in shape, smooth on the surface, and flattened on the sides. It is suspended obliquely, so that the upper part is directed forwards and somewhat outwards, and the lower end projects backwards and rather inwards. The anterior margin is convex, and the posterior, which is flatter, is pierced by the spermatic vessels and nerves. Stretching like an arch along the outer part of the testis is the epididymis, or the convoluted part of the excretory duct of the organ; and attached to the upper part of the testis or of the epididymis is a small body, two or three lines in length, whose use is unknown.

Form oval; suspended obliquely.

Margins.

Bodies on the testicle.

Size and weight.—In length the testis is an inch and a half or two inches; but it measures from before backwards rather more than an inch, and from side to side rather less than an inch. Its weight is nearly an ounce, and the left is frequently larger than the other.

Dimensions and weight.

STRUCTURE.—The substance of the testicle is composed of minute secerning tubes, that end in one excretory or efferent duct, named vas deferens. Around the tubes the blood-vessels are disposed in plexuses. Surrounding and supporting the delicate seminiferal tubes is the dense covering of the tunica albuginea.

A dense tunic contains small secreting tubes.

Dissection.—For the purpose of examining the investing fibrous coat, place the testis on its outer side, viz. that on which the epididymis lies, and fix it in that position with pins. Then cut through the fibrous coat along the anterior part of the testis, and raise it as far backwards as to the entrance of the blood-vessels. In this proceeding a number of fine bands will be seen traversing the substance of the testicle, and a short septal piece (mediastinum) will be observed at the back of the viscus, where the vessels enter. It will afterwards be necessary to remove part of the testicular mass of tubes to bring into view the mediastinum, and to trace back some of the finer septa to it.

How to see the structure of the testis.

The *tunica albuginea*, or the strong fibrous coat of the testicle, is of a bluish-white colour, and resembles in appearance and structure the sclerotic coat of the eye-ball. This membrane supports the soft glandular part of the testicle, and maintains the shape of the organ by reason of its dense and unyielding nature. Besides determining the general

Fibrous coat; characters;

use.

Sends inwards processes,

form, it sends inwards processes to support and separate the seminal tubes; and one of these, which is larger than the rest, is placed at the back of the testicle, along with the vessels, and is named mediastinum. These several offsets of the membrane are seen in the dissection that has been made.

which are mediastinum

The mediastinum testis (corpus Highmorianum) is the thick process at the back of the gland, which projects inwards with the blood-vessels for the distance of a few lines. It extends from the upper nearly to the lower part of the testis, and is larger and deeper above than below. To its front and sides are connected the finer septal processes; and in its interior (for it is said to be formed of two lateral pieces united at an acute angle in front) are contained the blood-vessels, and a network of seminal ducts forming the rete testis.

and finer septa.

Of the finer processes of the tunica albuginea, there are two kinds: one set are round, cord-like, but of different lengths, which are fixed posteriorly to the mediastinum, and serve to maintain the shape of the testis; the other set form delicate membranous septa, which divide the seminal tubes into lobes, and are continued, like the others, to join the mediastinum.

A vascular layer lines it (tunica vasculosa).

Within the tunica albuginea is a thin vascular layer, the *tunica vasculosa* of Sir A. Cooper, which lines the fibrous coat, and covers the different septa in the interior of the gland. It is formed of the ramifications of the blood-vessels united by areolar tissue, like the pia mater of the brain, and in it the vessels are subdivided before they are distributed on the secerning tubes.

Seminal tubes;

Seminal tubes (tubuli seminiferi).—These secerning tubes are the minute branched extremities of the duct or vas deferens.

appearance and

They are very wavy, and are but slightly held together by fine cellular tissue and surrounding blood-vessels, so that they may be readily drawn out of the testis for some distance.

length;

Their length is said by Monro to be sixteen feet, but by Lauth to be only two feet and a quarter. The size and the characters of the minute tubules can be learned only with the aid of the microscope. Towards the circumference of the testis, the tubes have for the most part closed extremi-

communications;

ties, but some communicate, forming loops or arches, and

some are further united deeper in the gland. The diameter of the tubules varies from $\frac{1}{200}$th to $\frac{1}{150}$th of an inch. The wall of the tubuli, though thin, has considerable strength: lining the interior is a nucleated granular epithelium, and on the exterior is a plexus of blood-vessels.

size; struc-ture.

From the disposition and appearance of the seminal tubes, the several parts of the testis take their name. Thus, where they are collected into separate masses, they form the lobes of the testis; as they enter the mediastinum testis they are named vasa recta; where they communicate in the mediastinum they produce the rete testis; and, lastly, as they leave the upper part of the gland, and become convoluted, they are called coni vasculosi.

Tubes change their name.

The *lobes of the testis* are formed, as above explained, by bundles of the seminiferal tubes, and are situate in the intervals between the processes sent inwards from the tunica albuginea. The number of these is differently stated: according to one authority (Berres) they are 250; but according to another (Krause), 400 or more. They are conical in form, with the base of each turned to the circumference, and the apex to the mediastinum testis. Each is made up of one, two, or more tortuous seminal tubules; and the tubes of one lobe are sometimes united with those of the neighbouring lobes. Towards the apex of each lobe the tubules become less bent, but they are united together; and the tubuli of the several lobes are further joined at the same spot into larger canals that form the tubuli recti.

They form the lobes, number; form. Tubes in them and arrange-ment.

Tubuli recti, *rete testis*, and *vasa efferentia*.—The seminal tubes that issue from the several lobes become larger in size and straighter in direction, and are named *tubuli recti* or vasa recta. They are about twenty in number, and pierce the fibrous mediastinum, entering into its interior. In the substance of the mediastinum the tubes lose their former name, and are directed to the upper end of the testis. They are situate in the anterior part of that fibrous process, in front of the blood-vessels, and freely communicate, so as to form a network, called *rete testis*. About twelve or twenty seminal tubes issue from the top of the rete testis, and leave the upper part of the testicle as the *vasa efferentia*. These are larger

They next become straight (tubuli recti); after-wards join to-gether (rete testis),

and then leave the gland (vasa efferentia). than the tubes of which they are the continuation, and end in the common excretory duct. Though straight at first, they soon become convoluted; whence the name *coni vasculosi* that has been given to them. When they are unravelled, they are found to be from six to eight inches long, and to join the excretory duct at intervals of about three inches.

Excretory duct. The EXCRETORY DUCT of the testis receives the vasa efferentia from the upper part of the gland, and extends thence to the urethra. Its first part, which is in contact with the testis, is very flexuous, and forms the epididymis; but the remainder is straight, and is named vas deferens.

is bent on the testicle forming epididymis; The *epididymis* extends, in the form of an arch, along the outer side of the testis, from the upper to the lower end, and receives its name from its situation. Opposite the upper part of the testicle it presents an enlarged portion or head (*globus major*), and at the lower part of that organ it becomes more pointed or tail-like (*globus minor*), before ending in the vas deferens. how named; The intervening narrow part of the epididymis is called the body. Its head is attached to the testis by the vasa efferentia that open into it; and its tail or lower part is fixed to the tunica albuginea by some fibrous tissue, is but a single tube; and by the reflection of the tunica vaginalis. After the removal of the serous membrane and fibrous tissue, the epididymis will be seen to be formed of a single tube, bent into a zigzag form, whose bends are united by fibrous tissue into length and size. one mass. This tube, when unravelled, measures twenty feet in length. The diameter of its canal is about $\frac{1}{70}$th of an inch; but there is a slight diminution in size towards the globus minor.

Where it is straight it is the vas deferens; The *vas deferens* begins opposite the lower end of the testis, at the termination of the globus minor of the epididymis. At first this part of the excretory duct is slightly wavy, but afterwards it becomes a firm round tube. In its course to the urethra it ascends on the inner side of the this opens into the urethra; testicle to reach the blood-vessels, with which it enters the internal abdominal ring; and it is then directed along the side of the bladder, and through the prostate, to open on the inner surface of the latter (see PELVIC VISCERA). length and size. The length of this part of the excretory duct is about two feet,

and the width of its canal about $\frac{1}{30}$th of an inch. Near its termination the vas deferens becomes enlarged and tortuous; but this condition will be referred to with the viscera of the pelvis.

Connected with the vas deferens, in the angle of union between it and the epididymis, is sometimes found a small narrow cæcal tube, the *vas aberrans* of Haller. This body is convoluted, and projects upwards about two or three inches amongst the vessels of the testicle. Like the epididymis, it is much longer when it is unravelled, measuring fourteen inches sometimes in this condition, but it may not exceed an inch and a half in length. Its capacity is greatest at the end. Its use is unknown. The vas aberrans may be found divided or doubled. Vas aberrans occasionally present; situation and size.

Structure.—The excretory duct of the testis is formed by a thick, special, elastic coat, which is covered externally by cellular tissue, and lined internally by epithelium. To the feel the duct is firm and wiry, like whip-cord, and on a section its wall is dense and of a yellow colour, but it is thinnest at the head of the epididymis. The *special coat* is composed of longitudinal and circular pale fibres (? muscular), the former being in greatest abundance. The *mucous membrane* is marked by longitudinal ridges in the straight part of the canal, and by irregular ones in the sacculated part. A columnar epithelium covers the inner surface. Two coats form the duct; a fibrous and a mucous.

The canal of the vas deferens is larger than that of the epididymis, as before stated. The vas aberrans resembles the vas deferens in structure. Vas aberrans like the duct.

Blood-vessels of the testicle.—The branches of the *spermatic artery* pierce the back of the testis, and enter the posterior part of the mediastinum behind the rete testis. Leaving the mediastinum the vessels are finely divided to form the vascular membrane that lines the interior of the tunica albuginea. After being thus divided, offsets are continued on the fine septa between the lobes to the seminal tubules, on which they are distributed. The *spermatic veins* begin in the plexuses around the seminal tubes, and issue from the gland at the posterior part; they then ascend along the cord, forming a plexus, and end in one trunk which joins the vena cava on the right side and the renal vein on the left (p. 520.). The *lymphatics* ascend on the blood vessels, and join the lumbar glands. The *nerves* are derived from the sympathetic. Artery. Veins. Lymphatics and nerves.

Vessels of the duct. A special blood-vessel (artery of the vas deferens) is furnished to the excretory duct from the upper vesical artery; and some veins from the epididymis enter the spermatic veins.

Section V.

AORTA AND VENA CAVA, AND THE DEEP MUSCLES.

Dissect blood-vessels and muscles. After the body is replaced in its former position (on the back) the student should prepare for examination the large vessels and their branches, with the remaining muscles of the abdomen.

To see the diaphragm. *Dissection.*—The peritoneum is to be removed from the surface of the diaphragm, especially from the central tendinous part, and from the fleshy processes or pillars which are fixed to the lumbar vertebræ. On the right side the dissector should define two aponeurotic bands (arches), which give attachment to the muscular fibres — one curves over the psoas muscle, and the other extends from the transverse process of the first lumbar vertebra to the last rib.

Aorta, cava, and branches. Take from the surface of the aorta and vena cava some cellular membrane with the sympathetic nerve and the lymphatic glands, and clean their branches to the diaphragm, to the kidney and supra-renal body, to the testicle, and to the lumbar vertebræ and the spinal cord. In like manner expose the large iliac divisions of the aorta and cava, as far as Poupart's ligament. The ureter and the spermatic vessels are to be cleaned as they cross the iliac artery; and on this artery, branches of a small nerve (genito-crural), are to be sought near the thigh.

Psoas. On the right side clean the surface of the psoas muscle along the side of the spine; but on the left side show the fascia covering the muscle, and clear away the fat from about the kidney. Nerves of lumbar plexus. On the surface of the muscle, and in the fat external to it, will be found the branches of the lumbar plexus. On the anterior aspect is the genito-crural nerve. Issuing at the outer border are four nerves: — the ilio-hypogastric and ilio-inguinal near the top, the external cutaneous about the centre, and the large anterior crural at the lower part. Along the inner border of the muscle is the gangliated cord of the sympathetic, with a chain of lumbar lymphatic glands; and somewhat below the pelvic part of the muscle is the obturator

nerve. External to the psoas is the quadratus lumborum muscle, and crossing it near the last rib is the last dorsal nerve, with an artery. In the hollow of the os ilii is the iliacus muscle, which, with the preceding, may be cleaned on the right side, whilst the fascia that covers them may be observed on the opposite side. Quadratus lumborum. Iliacus muscle.

The ABDOMINAL AORTA extends from opposite the last dorsal vertebra to the left side of the body of the fourth lumbar vertebra, where it divides into the common iliac arteries. Its commencement is between the fleshy pillars of the diaphragm, and its termination is nearly on a level with the highest part of the crest of the ilium. The connections of the vessel with surrounding parts have been before referred to (p. 464.), and its branches now remain to be examined. Extent of the aorta. Connections.

The *branches* of the aorta are numerous, and arise in the following order: — First, are the diaphragmatic arteries, two in number, which, if they arise separately, leave the sides of the aorta immediately it appears in the abdomen. Close to the tendinous ring of the diaphragm the single trunk of the cœliac axis arises from the front of the aorta; and about a quarter of an inch lower down, also on its front, is the trunk of the superior mesenteric artery. Half an inch lower the renal arteries, right and left, take origin from the sides of the aorta. From the fore part of the trunk, close above each renal, is the small capsular branch, and below it is the spermatic artery. From the front of the aorta, one to two inches above the bifurcation, springs the superior mesenteric artery; and from the angle of division the small middle sacral artery runs downwards. Four or five small lumbar arteries on each side come from the posterior part of the aorta, opposite the bodies of the vertebræ. Place of origin of the branches;

The branches may be further classified into two sets, — those that supply the viscera of the abdomen (visceral), and those that are furnished to the abdominal walls (parietal). their classification.

A. The *visceral branches* are cœliac axis, superior and inferior mesenteric, renal, capsular, and spermatic. Of this set all, except the three last, viz. the renal, capsular, and spermatic, have been examined (p. 458—470.). Visceral branches.

The *renal arteries* leave the aorta nearly at a right angle, and are directed outwards, one on each side. Near the kidney each divides into four or five branches, which enter Renal artery.

is beneath its vein; gives offsets. its substance between the vein and the ureter. Each lies beneath its companion vein, being surrounded by a plexus of nerves, and supplies small twigs to the supra-renal capsule (inferior capsular), to the ureter, and to the cellular membrane about the kidney.

Difference between left and right. The arteries of opposite sides have some differences. The left is the shortest, owing to the position of the aorta. The right crosses the spine, passing beneath the vena cava, and is placed beneath its companion vein. Varieties, both in the number and place of origin of this artery, are frequent.

Capsular artery. The *capsular artery* (middle) is a small branch that runs almost transversely outwards to the supra-renal body, to which it is distributed. This artery anastomoses with the other branches supplied to the supra-renal body by the renal and phrenic arteries. It is of large size in the fetus.

Spermatic artery is remarkable. The *spermatic artery* is destined for the testicle, and is remarkable in being small in size in proportion to its length, in leaving the cavity of the abdomen, and in having the part in the abdomen straight, but that in the cord tortuous. Course to the testicle. From its origin below the renal, the vessel passes downwards along the posterior wall of the abdomen, beneath the peritoneum, to the internal abdominal ring, where it enters the spermatic cord, as before described (p. 432.). In the course specified, the vessel passes along the front of the psoas, crossing over the ureter and the external or the common iliac artery, and as it leaves the abdomen it turns round the epigastric artery, but is separated from it by the vas deferens. On the right side the artery crosses the vena cava. It is accompanied by the spermatic vein, and by the spermatic plexus of nerves.

In the female. In the female the corresponding artery (ovarian) descends into the pelvis to the ovary and uterus.

Condition in fetus. In the fetus, before the testicle leaves the abdomen, the spermatic artery is very short, but the vessel is elongated in proportion as the part supplied is removed from its former site.

Branches to wall of abdomen. B. The *parietal branches* of the aorta are the phrenic, lumbar, and middle sacral arteries.

The *diaphragmatic* or *inferior phrenic arteries* are directed

upwards and outwards along the under surface of the diaphragm, near the posterior part, and end in branches to that muscle, as well as in branches to anastomose with the surrounding arteries. The left artery passes behind the œsophageal opening, and the right behind the vena cava. Each ends in two branches: — one (internal) passes onwards towards the fore part of the diaphragm, and anastomoses with its fellow of the opposite side, and with the branch to the diaphragm (musculo-phrenic), from the internal mammary; the other (external) is larger, and is directed outwards to the side of the muscle, where it meets with the intercostal arteries. Middle phrenic course of left and right. Distribution.

Small branches are supplied by the external division of this artery to the supra-renal body (superior capsular); and some twigs are given by the left artery to the œsophagus, and by the right to the vena cava. Small offsets.

The other parietal branches, viz. lumbar and middle sacral, are not dissected in this stage. The former will be seen after the lumbar plexus (p. 531.), and the latter in the pelvis.

The COMMON ILIAC ARTERY is directed outwards from the bifurcation of the aorta to the base of the sacrum, and divides into two large trunks: — one is for the supply of the lower limb (external iliac), and another for the pelvis (internal iliac). Extent and termination. Placed obliquely on the vertebral column, the vessel measures about two inches in length, and is covered by the peritoneum, also by branches of the sympathetic nerve, and sometimes by the ureter. Connections. To the outer side, near its termination, is the psoas muscle. It is accompanied by a vein of the same name. Usually it does not furnish any branch, but it may give origin to the ilio-lumbar, or one renal artery. Branches.

On opposite sides the vessels have some differences. The artery of the right side is rather the longest, in consequence of the position of the aorta on the left side of the spine. Its companion vein is at first beneath, but afterwards external to it, and this artery is also in front of the left common iliac vein. Difference between right On the left side the artery is crossed by the continu- and left vessel.

ation of the inferior mesenteric artery, and the corresponding vein is situate below it.

Place of origin and length change.

Peculiarities.—The place of origin changes with that of the bifurcation of the aorta, and the length varies from less than half an inch (in one case) to four inches and a half (Quain). Generally the left artery divides lower than the right.

This artery leads to lower limb.

Extent and direction.

The EXTERNAL ILIAC ARTERY is that part of the leading vessel of the lower limb which is contained in the cavity of the abdomen. Its extent is from the bifurcation of the common iliac to the lower border of Poupart's ligament (where it becomes femoral); and its direction would be indicated on the surface of the abdomen by a line from the left of the umbilicus to the middle of the space between the symphysis pubis and the crest of the ilium. The vessel lies above the brim of the pelvis, in its course to Poupart's ligament, and is covered closely by the peritoneum in all its extent. Near its origin it is crossed sometimes by the ureter, and near Poupart's ligament the thick layer of subperitoneal fat conceals the artery, and the spermatic vessels and part of the genito-crural nerve here lie on it for a short distance; but before the artery leaves the abdomen, the circumflex iliac vein crosses it, and the vas deferens bends down along its inner side. To the outer side of the vessel is the psoas muscle, except at Poupart's ligament, where the artery lies on the psoas. A chain of lymphatic glands is placed along the inner side of the vessel. The position of the external iliac vein is not the same on both sides. On the left side the vein is internal to the artery all the way; whilst on the right side the vein has the same position on the pubes, but it afterwards passes beneath the arterial trunk.

Connections with parts around,

and with vein.

Two branches.

Two large *branches*, epigastric and circumflex iliac, arise from the artery near its end, and are distributed to the wall of the abdomen (p. 434.). Some small unnamed twigs are also given by it to the psoas muscle and to the lymphatic glands.

Occasional branches from it.

Peculiarities.—Though the trunk of the vessel is commonly free from any large artery till near Poupart's ligament, it may be occupied about the middle by the origin of the obturator artery, or further on by the internal circumflex artery of the thigh.

VEINS. — The veins of the abdomen correspond so closely to the arteries, both in the number, extent, and connections of the trunks, that it will be unnecessary to go into the same detail as in the description of the arteries. Further, as the veins increase in size, from the circumference towards the centre of the body, those most distant from the heart will be first described. Veins of the abdomen, except vena portæ.

The *external iliac* is the continuation of the femoral vein into the abdomen beneath Poupart's ligament. It has the same extent as the artery of the same name, and ends by uniting with the vein from the pelvis (internal iliac) to form the common iliac vein. On the pubes the vein is on the same level as the artery, and lies on the bone between the psoas and pectineus muscles; but this position is not retained throughout, for though the left vein remains internal to, the right slips beneath its artery. Anatomy of external iliac. Position to artery.

The veins that open into it are the epigastric and circumflex iliac (p. 434.). Branches.

The *common iliac vein* ascends by the side of its companion artery, the right almost vertically, and the left obliquely, to the right side of the body of the fifth lumbar vertebra (its upper part), where the two are blended in one trunk — the vena cava. The right vein is the shortest, and is at first behind, but afterwards outside the artery of the same side. The left is altogether below the artery of that side, and moreover crosses beneath the right common iliac artery. Common iliac veins form cava. Difference in length and connections.

Each receives the ilio-lumbar, and sometimes the lateral sacral vein; and the middle sacral vein also ends in the common iliac of the left side. Veins to it.

Instead of the common iliac veins uniting at the spot mentioned, they may be continued upwards, one on each side of the aorta, as high as the kidney, before the left crosses that vessel to join the right, and give origin to the vena cava. In these cases the vein on the left side receives one renal vein, and the two common iliacs are connected by a small intervening branch at the spot where they are commonly united. Place where the veins join may change.

The VENA CAVA INFERIOR collects and conveys to the heart the blood of the lower half of the body. Taking Lower cava is by side

of the aorta. origin, as before said, on the right side of the fifth lumbar vertebra, rather below the bifurcation of the aorta, this large vein ascends on the right side of the vertebral column, and reaches the heart by perforating the diaphragm. Its connections with the surrounding parts have been already described (p. 465.).

Extent and connections.

Branches from abdomen, In this course the cava receives parietal branches from the wall of the abdomen and the diaphragm, and visceral branches from the testicle, the kidney, the supra-renal body, and the liver. The veins belonging to the digestive apparatus, viz. to the intestinal canal, the spleen, and the pancreas, are united to form the vena portæ (p. 470.); but the blood circulating in these veins reaches finally the cava through the indirect channel of the veins of the liver.

except digestive apparatus.

Lumbar veins after. The *lumbar veins* enter the posterior part of the vena cava, and correspond in number and course to the arteries of the same name: they will be dissected with those arteries.

Spermatic vein The *spermatic vein* enters the abdomen by the internal abdominal ring, after forming the spermatic plexus in the cord (p. 432.). At first the vein consists of two branches in the abdomen, which lie on the sides of the spermatic artery; but these soon merge into one trunk, which ends on the left side in the renal vein, opening into it at right angles; and on the right side in the inferior cava, which it pierces obliquely below the renal vein. As the vein ascends to its destination, it receives one or more branches from the wall of the abdomen, and from the fat about the kidney.

ends differently on left and right sides.

Vein in the female. In the female this vein (ovarian) has the same ending as in the male, and it forms a plexus in the broad ligament of the uterus.

Renal vein; The *renal* or *emulgent vein* is of large size, and joins the vena cava at a right angle. It commences, by many branches, in the kidney; and the trunk resulting from their union is superficial to the renal artery. The right is the shortest, and joins the cava higher up than the other. The left vein crosses the aorta close to the origin of the superior mesenteric artery.

position to artery; difference on two sides.

Branches. Each vein receives branches from the supra-renal capsule, and the left is joined by the spermatic vein of the same side.

The *supra-renal vein* is of considerable size when a comparison is made between it and the body from which it comes. On the right side it opens into the cava, and on the left side into the renal vein. Supra-renal ends differently.

The *diaphragmatic veins* (inferior), two for each artery, spring from the under surface of the diaphragm. They join the cava either as one trunk or two. Phrenic veins.

The *hepatic veins* enter the cava where it is in contact with the liver. These veins are described in the dissection of the liver (p. 499.). Hepatic veins, before noticed.

Peculiarities of the vena cava.—Where transposition of the viscera exists the vena cava and the aorta change sides. But without that transposition the vein may be on the left side of the aorta as high as the renal vein, before it crosses that vessel to take its usual place. Or the inferior cava may enter the azygos vein, and the blood from the lower part of the body be then transmitted to the heart by the superior cava; when this deviation exists the hepatic veins form a separate trunk, which opens into the right auricle in the situation of the inferior cava. Vena cava may be also on left side, or in part, or may end in the azygos vein.

THE DEEP MUSCLES.

The muscles in the interior of the abdomen are the diaphragm, psoas, iliacus, and quadratus lumborum. Some fasciæ are also to be seen in connection with the muscles. These muscles are,

The DIAPHRAGM is a vaulted moveable partition between the thorax and the abdomen. It is concave towards the latter cavity, where it is marked by a central tendon, and is attached externally, by a muscular part, to the surrounding ribs and to the spinal column. Diaphragm. Situation and form. The *origin* of the muscle is similar on each side of the middle line: thus, beginning in front and passing backwards, it will be found connected by fleshy fibres with the posterior part of the xiphoid cartilage, and with the inner aspect of the six lower ribs; with two aponeurotic arches between the last rib and the vertebræ, one being placed over the quadratus lumborum, and the other over the psoas muscle; and, lastly, it is connected with the bodies of the lumbar vertebræ by a thick muscular part (pillar). Origin at the circumference. From this extensive origin at the circumference, the fibres Insertion

of fibres into a central tendon. are directed, with different degrees of obliquity and length, to the central median tendon ; and with peculiarities of disposition in some fibres (those of the pillars) which will be examined afterwards more in detail. The muscle arches higher on the right than the left side, and is covered for the most part by peritoneum. In contact with it, on the right side, are the liver and kidney ; and on the left side, the stomach, the spleen, and the left kidney: in contact also with the pillars is the pancreas, with the solar plexus and the semilunar ganglia. The thoracic surface is covered by the pleura and by the pericardium, and is convex towards the thorax (p. 350). At the circumference of the muscle, the fleshy processes of origin alternate with like parts of the transversalis muscle. A cellular interval separates the attachments to the xiphoid cartilage and the seventh rib; and there is also another interval sometimes between the fibres from the last rib and those from the arch over the quadratus lumborum muscle. In the diaphragm are certain apertures for the transmission of parts from the thorax to the abdomen, viz. one for the œsophagus, another for the vena cava, and a third for the aorta between the pillars of the muscle and the spinal column : moreover, the pillars are perforated by the splanchnic and sympathetic nerves.

Parts in contact with the under surface,

and with the upper.

Attachment of border.

Apertures in the muscle.

Special parts to be examined.

The following parts, that have been mentioned incidentally in describing the diaphragm, are now to be noticed more fully : they are the central tendon, the pillars, and the arches and apertures.

Central tendon,

The *central tendon* (tendo diaphragmatis, cordiform tendon) is situate at the highest part of the diaphragm, and is surrounded by muscular fibres. It is of a pearly white colour, and its tendinous fibres cross in different planes and in different directions. In form it resembles a trefoil leaf, of which the central part is the largest, whilst the left division (ala) is the smallest.

like a trefoil leaf.

Two pillars,

The *pillars* (crura appendices) are two large fleshy processes, one on each side of the abdominal aorta, which are connected with the lumbar vertebræ. Each is pointed and tendinous below, where it is attached to the vertebræ, but large and fleshy at the upper part; and between them is a

with certain resemblances

tendinous arch over the aorta. The pillars differ somewhat on opposite sides: thus the *right* is the larger of the two, and is fixed by tendinous processes to the bodies of the first three lumbar vertebræ, to their intervertebral substance, and to the fibro-cartilage between the third and fourth vertebræ. The *left* pillar, which is situate more on the side of the spine, is partly concealed by the aorta, and does not reach so far as the right by the depth of a vertebra or of an intervertebral substance. In each pillar the fleshy fibres that succeed to the tendon pass upwards and forwards, diverging from each other. The external and middle join at once the central tendon. But the internal fibres ascend by the side of the aorta and pass to the opposite side, decussating between that vessel and the opening of the œsophagus with those of its fellow; having changed sides, these fibres are directed upwards to the central tendon around the œsophagean opening, which they limit. In the decussation between the aorta and the œsophagus the fasciculus of fibres from the right crus is larger than that from the left, and is anterior to it.

and differences.

Arrangement of fibres in each,

as they ascend to the tendon.

The *arches* (ligamenta arcuata) are two fibrous bands over the quadratus lumborum and psoas muscles on each side. The arch over the psoas (lig. arcuatum internum) is the strongest, and is connected by the one end to the tendinous part of the pillar of the diaphragm, and by the other end to the transverse process of the first or second lumbar vertebra. The external arch over the quadratus lumborum muscle (lig. arcuat. externum) is only a thickened part of the fascia covering that muscle, and extends from the same transverse process (first or second lumbar) to the last rib. As before said, fleshy fibres take origin from both bands.

Two arches,

internal or true,

and external or false.

The *apertures* in the diaphragm are three large ones for the aorta, the vena cava, and the œsophagus, with some smaller ones for nerves and vessels. The opening for the aorta is rather behind than in the diaphragm, for it is situate between the pillars of the muscle and the spinal column: it transmits the aorta, the thoracic duct, and sometimes the vena azygos. The opening for the œsophagus and pneumogastric nerves is rather above and to the left of the aortic

Apertures are—

For the aorta;

its contents.

For œsophagus and nerves.

aperture. It is situate in the muscular part of the diaphragm, and is formed by the fibres of the pillars, as above explained. The opening for the vena cava is placed in the right division of the central tendon, or between the right and middle pieces, and its margins are attached to the vein by tendinous fibres. It is described as being of a square form (foramen quadratum).

For the vena cava.

Fissures in the pillars.

There is a *fissure* in each pillar for the splanchnic nerves, with one in the left for the small azygos vein. Sometimes the large azygos vein pierces the right pillar instead of passing with the aorta.

Take away greater part of the diaphragm.

Dissection. — After the diaphragm has been learnt, cut through the ribs that support it on each side, and take away the pieces of the ribs together with all the diaphragm, except the pillars and arches at the posterior part. On the right side of the body the following muscles are to be seen; on the left, the fascia covering them.

Psoas magnus; situation; origin.

The PSOAS MAGNUS reaches from the lumbar vertebræ to the femur, and is situate partly in the abdomen and partly in the thigh. The muscle *arises* from the anterior aspect of the transverse processes of the lumbar vertebræ, and from the side of the bodies of the last dorsal and all the lumbar vertebræ by five processes, which are connected each to the upper and lower border of two contiguous vertebræ, and to their intervertebral substance. The fibres are directed downwards, and give rise to a roundish muscle, which gradually diminishes towards Poupart's ligament. Inferiorly the muscle ends in a tendon on the outer aspect, which receives the fibres of the iliacus, and passes beneath Poupart's ligament to be *inserted* behind the small trochanter of the femur, and into the contiguous part of the bone.

Direction of the fibres.

Insertion.

Connections in front,

The abdominal part of the muscle has the following connections: — in front of it are the internal arch of the diaphragm, the kidney with its vessels and duct, the spermatic vessels and the genito-crural nerve, and, near Poupart's ligament, the external iliac artery. Posteriorly the muscle is in contact with the transverse processes, with part of the quadratus lumborum, and with the innominate bone. The outer border touches the quadratus and iliacus, and branches

behind;

of outer border,

of the lumbar plexus issue from beneath it. The inner border is partly connected to the vertebræ, and is partly free along the margin of the pelvis. Along the vertebral part of this border lie the sympathetic nerve and some lumbar glands, with the cava on the right, and the aorta on the left side; along the pelvic part of the muscle are the external iliac artery and vein, and the obturator nerve is below it. It has been before said that the muscle is connected only with the margins of the vertebræ; and it may be seen that opposite the centre of those bones the fibres are attached to tendinous arches over the lumbar vessels.

of inner border; along pelvic and vertebral part.

PSOAS PARVUS is a small muscle with a flat tendon, which is placed on the front of the large psoas. Its fibres *arise* from the last dorsal and from the upper lumbar vertebra, and the intervening fibro-cartilage, and end in a tendon, which becomes broader inferiorly, and is *inserted* into the ilio-pectinal eminence and brim of the pelvis. The tendon is connected with the fascia covering the iliacus muscle. This muscle is rarely present.

Psoas parvus; origin; insertion; often absent.

The ILIACUS MUSCLE occupies the hollow (iliac fossa) on the inner aspect of the os ilii, and is blended inferiorly with the psoas muscle. It is triangular in form, and has a fleshy *origin* from the iliac fossa and ilio-lumbar ligament, sometimes from the base of the sacrum, and in front from the capsule of the hip-joint. The fibres pass inwards to the tendon of the psoas, uniting with it even to its *insertion* into the femur, and some reach separately that bone. Above Poupart's ligament the muscle is covered on both sides by the iliac fascia; but on the right side the cæcum is in front of it, whilst on the left the sigmoid flexure conceals it. Beneath it are the innominate bone and the capsule of the hip-joint. The inner margin is in contact with the psoas and the anterior crural nerve. The connections of the united psoas and iliacus below Poupart's ligament are given with the dissection of the thigh.

Iliacus has the form of the iliac fossa. origin; insertion; parts covering it on opposite sides. To the inner side is the psoas.

The QUADRATUS LUMBORUM is a short thick muscle intervening between the crest of the ilium and the last rib, which consists of two parts, inner and outer. The *outer part* arises inferiorly from the ilio-vertebral ligament, and from two

This muscle has two parts;—outer, which is largest,

and posterior;

inches of the crest of the ilium anterior to it. The fibres ascend, and are inserted by distinct fleshy and tendinous slips into the apices of the transverse processes of the four upper lumbar vertebræ, as well as into the body of the last dorsal vertebra and a small part of the last rib. The *inner part* is situate before the other, and arises from the tips of the three middle transverse processes of the lumbar vertebræ. Its fibres are directed backwards across the posterior, and are inserted into the lower border of the last rib. This muscle is incased in a sheath derived from the fascia lumborum. Crossing the surface are branches of the lumbar plexus, together with the last dorsal nerve. Beneath the quadratus is the mass of the erector spinæ muscle.

and inner, or anterior.

It is contained in a sheath.

Fascia of the quadratus

Fascia of the quadratus. Covering the surface of the quadratus is a thin membrane which is derived from the tendon of the transversalis abdominis (fascia lumborum, p. 363.), and passes in front of the quadratus to be fixed to the roots of the transverse processes, to the crest of the ilium, and to the last rib. It is this fascia that forms the thickened band called ligamentum arcuatum externum.

forms lig. arc. extern.

Iliac fascia

Fascia of the iliacus and psoas. — This fascia covers the two muscles, and extends in different directions as far as their attachments. Over the iliacus muscle the membrane is thickest; and when the tendon of the small psoas muscle is present a strong accession is received from it. The disposition of the fascia at Poupart's ligament, and the part that it takes in the formation of the femoral sheath have been before explained (p. 444.) When traced inwards over the psoas the fascia is found to be inserted into the os ilii near the brim of the pelvis; and when followed upwards it is seen to become thin, and to be fixed on the one side to the lumbar vertebræ and the ligamentum arcuatum internum, whilst on the other it is blended with the fascia on the quadratus. At its attachment to the vertebræ the fascia has the same digitate and arched condition as the muscle. The fascia should be divided over the psoas on the left side, and reflected towards the brim of the pelvis.

joined by tendon of small psoas

attachments below

internally both to pelvis

and the vertebræ.

Trace the lymphatics.

Dissection. — The student is now to clean the lymphatic glands along the vertebræ, and to trace upwards some lymphatic vessels

to the thoracic duct. To expose the commencement of the duct divide the diaphragm over the aorta, and throw its pillars to each side, then cut through the aorta with care, and take out a piece of it. Now the beginning of the duct (chyli receptaculum) and of the vena azygos will be well seen, and may be followed upwards into the thorax. On the left side the student may trace the splanchnic nerves and the small vena azygos through the pillar of the diaphragm, and show the trunk of the sympathetic nerve entering the abdomen beneath the arch over the psoas muscle.

Receptaculum. Azygos veins.

Splanchnic nerves.

Lymphatic glands. — A chain of glands is placed along the side of the external iliac artery, and along the front and sides of the lumbar vertebræ; these are connected by short tubes which increase in size and diminish in number until at the upper part of the lumbar vertebræ only the three trunks remain that unite to form the thoracic duct. Into these glands run the lymphatics of the lower limb, those of the viscera and wall of the abdomen, and of the genital organs and testicle.

Lumbar lymphatics of the abdomen end in one duct.

Ducts entering glands.

Receptaculum chyli. — The thoracic duct begins in the abdomen, by the union of three or four large lymphatic vessels. Its commencement is marked by a considerable dilatation, which is named as above, and is placed on the right side of the aorta, about opposite the second lumbar vertebra. The duct then enters the thorax by passing through the diaphragm with the aorta.

Beginning of the thoracic duct, on right of aorta, at second lumbar vertebra.

Beginning of the azygos veins. — The right vein (vena azygos major) begins opposite the first or second lumbar vertebra by a small branch that is continuous with a lumbar vein, or it may be with the vena cava or the renal vein. However formed, the vein enters the thorax with the thoracic duct and the aorta, to the right of which it lies. This vein may pierce the crus of the diaphragm. The left or small azygos vein begins on the left side of the spine, joining here one of the lumbar veins or the renal vein, and passes through the pillar of the diaphragm, or through the aortic opening. The anatomy of these veins is given with the thorax, p. 343.

Large azygos vein; entrance into thorax.

Small azygos vein.

SECTION VI.

LUMBAR PLEXUS AND THE CORD OF THE SYMPATHETIC.

Dissection of the lumbar plexus, and of the nerves joining it.

Dissection. — To bring into view the lumbar plexus and the nerves by which it is formed, the dissector should scrape away the psoas muscle on the left side. On the right side the psoas may be left untouched to see at what places the branches issue from it. For the most part the fleshy fibres may be removed freely; but a small branch (accessory of the obturator) should be looked for at the inner border of the muscle. Next follow along the lumbar arteries the branches of the sympathetic that join the spinal nerves. In the substance of the quadratus lumborum a communication may sometimes be found between the last dorsal and the first lumbar nerve.

Four lumbar nerves enter the plexus, and supply muscles;

SPINAL LUMBAR NERVES. — The anterior divisions of the lumbar nerves, except the last, enter into the lumbar plexus. Five in number, they increase in size from the first to the last, and are joined by filaments of the sympathetic near the intervertebral foramina. They supply branches also to the psoas and quadratus lumborum muscles.

fifth to the sacral plexus named lumbo-sacral.

The fifth or lowest nerve receives a communicating branch from the fourth nerve, and descends into the pelvis to enter the sacral plexus. After this nerve is joined by the offset from the fourth, the name *lumbo-sacral* is applied to the common trunk.

Plexus how formed. Situation. Connections with nerves.

The LUMBAR PLEXUS is formed by loops of communication between the four highest lumbar nerves. Contained in the substance of the psoas, near its posterior part, the plexus increases in size from above downwards, like the individual nerves. Superiorly a connection is sometimes found between the first lumbar and the last dorsal nerve, and inferiorly the large lumbo-sacral cord unites the lumbar and sacral plexuses.

Six branches, viz.

The *branches* of the plexus supply the lower part of the abdominal wall, the fore part of the thigh, and the inner side of the leg; they are six in number, as below: —

ilio-hypogastric

1. The *ilio-hypogastric branch* comes from the first nerve, and appears at the outer border of the psoas muscle, near the

upper part. This branch is then directed over the quadratus lumborum to the crest of the ilium, and enters the wall of the abdomen by piercing the transversalis abdominis. Its termination in the integuments of the buttock and abdomen by means of an iliac and a hypogastric branch has been already seen (p. 417.). is the first branch. Course in abdomen.

2. The *ilio-inguinal branch* arises with the preceding from the first nerve, and issues from the psoas at the same spot. Of smaller size than the ilio-hypogastric, and lower than it, this branch courses outwards over the quadratus and iliacus muscles towards the front of the crest of the ilium, where it also pierces the transversalis abdominis. The farther course of the nerve in the abdominal wall, and its distribution over the cord and groin, are before noticed (pp. 417. 429.). Ilio-inguinal arises with preceding, and accompanies it.

The size of this nerve depends upon that of the ilio-hypogastric branch; and the nerve may be absent if the latter is large. May be absent.

3. The *genito-crural branch* arises from the second lumbar nerve, and from the connecting loop between it and the first nerve. It pierces the fibres of the psoas, and descending on the surface of the muscle divides into a genital and a crural branch. Sometimes the nerve is divided in the psoas, and the branches perforate the muscle separately. Genito-crural pierces psoas, and divides into

a. The *genital branch* descends on the external iliac artery, and furnishes offsets around it; it passes from the abdomen with the spermatic vessels, to be distributed in the cremaster muscle. In the female the nerve is lost in the round ligament. genital and

b. The *crural branch* issues beneath Poupart's ligament to supply the integument of the thigh. See Cutaneous Nerves of the Thigh. crural branch.

4. The *external cutaneous nerve* of the thigh arises from the second nerve of the plexus, or from the loop between it and the third, and appears at the outer border of the psoas, about its middle. The nerve then takes an oblique course across the iliacus to the interval between the anterior spinous processes of the ilium, and leaves the abdomen beneath Course of this nerve in the abdomen to reach the thigh.

Poupart's ligament, to be distributed on the outer aspect of the thigh.

Origin of this nerve. 5. The *anterior crural nerve* is by far the largest offset of the plexus. Taking origin from the third and fourth nerves, and receiving a fasciculus also from the second, this large nerve appears at the lower part of the psoas. Here it lies in the hollow between that muscle and the iliacus, and passes to the thigh beneath Poupart's ligament. Before its final branching in the thigh, the nerve furnishes the following small twigs: —

Position in the abdomen; its branches here

to iliacus, Some small *branches* are given to the *iliacus muscle* from the outer side of the nerve whilst it is placed in the abdomen.

to femoral artery. A *branch to the femoral artery* is distributed around the upper part of that vessel. Its place of origin varies much.

Obturator nerve in the abdomen; 6. The *obturator nerve* is derived from the third and fourth nerves in the plexus, and is directed beneath the psoas to its inner or pelvic border. Escaped from beneath the muscle, the nerve crosses the pelvic cavity below the external iliac, but above the obturator vessels, and enters the thigh by means of the aperture in the upper part of the thyroid foramen. Occasionally the obturator gives origin to the following branch: —

to reach the thigh;

its accessory branch The *accessory obturator nerve* arises near the beginning of the trunk of the obturator, or from the third and fourth nerves of the plexus. Its course is along the inner border of the psoas, beneath the investing fascia, and over the surface of the os pubis to the thigh, where it ends by joining the obturator nerve, and supplying the hip joint.

supplies hip joint.

Sympathetic cord in the abdomen GANGLIATED CORD OF THE SYMPATHETIC. The lumbar part of the gangliated cord of the sympathetic in the abdomen is placed on each side of the spinal column, and is continuous upwards, beneath the inner arch of the diaphragm, with the thoracic part of that cord, and downwards with the pelvic part of the same. It lies along the inner border of the psoas muscle, nearer the front of the vertebræ than in the thorax, and is partly concealed on the right side by the vena cava. Each cord presents four or five oblong ganglia opposite the bodies of the vertebræ; and from these are supplied

joins that in thorax;

has four or five ganglia;

connecting branches to the spinal nerves, and branches of distribution.

a. Connecting branches. — From the outer part of each ganglion two small branches are directed backwards along the centre of the body of the vertebra with the lumbar artery, to unite with the anterior division of a spinal nerve near the intervertebral foramen. These branches are often divided between two spinal nerves. The connecting branches are longest in the lumbar region in consequence of the cord being carried forwards by the psoas muscle to the fore part of the vertebræ. their branches to either the spinal nerves

b. Branches of distribution. — Most of the internal branches throw themselves into the aortic and hypogastric plexuses, and by these means reach the viscera. Some filaments enter the vertebræ and their connecting ligaments. or the plexuses for the supply of the viscera.

Last dorsal nerve.—The anterior division of the last dorsal nerve resembles the other intercostal nerves in its distribution, but differs from them in being placed below the last rib. The nerve is directed outwards across the upper part of the quadratus lumborum, beneath the fascia covering it. At the outer border of that muscle it pierces the posterior aponeurosis of the transversalis abdominis (fascia lumborum), and enters the wall of the abdomen, where it ends in an abdominal and a cutaneous branch (p. 428). A small branch from the first lumbar artery accompanies the nerve. Near the spine it furnishes a small branch to the quadratus muscle, which may communicate with the first lumbar nerve. This nerve is like the intercostal. Course to wall of the abdomen.

The LUMBAR ARTERIES are some of the parietal branches of the aorta (p. 516.), and are furnished to the spinal canal and the wall of the abdomen. They resemble the aortic intercostal branches in their course and distribution. Commonly five in number on each side, these arteries arise opposite the centre of the vertebræ, and the vessels of opposite sides are sometimes joined in a common trunk: they then pass backwards in the hollow of the vertebræ, the upper two beneath the pillar of the diaphragm, and the lower ones beneath the psoas, to reach the intervals between the transverse processes, where each ends in an abdominal and a dorsal branch. The arteries of the right side pass beneath the cava. Five in number on each side, like the intercostal. Course and termination in

a branch to the back,

a. The *dorsal branch* continues onwards to the back between the transverse processes, and supplies a spinal branch to the spinal canal. The distribution of the artery is described with the vessels of the back and of the spinal cord (p. 373. 387.).

and a branch to the wall of the abdomen.

b. The *abdominal branch* is directed outwards beneath the quadratus lumborum, except that of the first, and sometimes that of the last nerve, which are or may be superficial to the muscle. The branches then enter the posterior part of the abdominal wall, the first being the largest, and anastomose with the lower intercostal, the circumflex iliac, and the ilio-lumbar arteries. These arteries supply the psoas and quadratus muscles. The size of the last two varies with that of the ilio-lumbar branch of the internal iliac artery.

The veins resemble the arteries,

The LUMBAR VEINS are the same in number, and have the same course as the arteries. Commencing by the union of a dorsal and an abdominal branch at the root of the transverse process, the trunk of the vein is directed forwards with the artery to the vena cava. These vessels open into the posterior part of the vena cava, either singly or conjointly with those of the opposite side. The veins of the left side are longer than those of the right, and pass beneath the aorta.

and open into the cava; left longest.

A plexus is formed around the transverse processes.

Beneath the psoas muscle the lumbar veins communicate freely around the transverse processes with one other, with the ilio-lumbar vein, and sometimes with the common iliac, so as to form a plexus of veins. Issuing from the plexus is a venous trunk (ascending lumbar vein), which joins on each side the azygos vein.

CAVITY OF THE PELVIS.

The cavity of the pelvis is but a part of the general space of the abdomen. It is situate below the brim or inlet of the true pelvis, and is bounded behind by the sacrum and coccyx, and, laterally and in front, by the innominate bones. Inferiorly, or towards the perinæum, the floor of the cavity is formed by the fascia reflected from the wall to the viscera, and by some muscles that will be afterwards seen. In the interior are contained the urinary bladder, the lower end of the rectum, and some of the generative organs, according to the sex. All these parts have vessels, nerves, and lymphatics connected with them, and the serous membrane is reflected over them.

Definition of the space here meant, with its situation and boundaries.

Contents.

Section I.

FASCIA OF THE PELVIS AND MUSCLES OF THE OUTLET.

On the wall of the pelvis is a thin fascia (pelvic), which extends from the brim to the outlet, and covers the obturator muscle. At a certain level a visceral layer is directed inwards from that membrane lining the wall, and is named recto-vesical fascia, from its attachment to the rectum and the bladder.

Outline of the fascia of the pelvis.

Dissection.—To expose the parietal layer, or the pelvic fascia, take away the external iliac vessels on the left side of the body, and the psoas if it has not been removed in the dissection of the lumbar plexus. Cut across the obturator vessels and nerve, and the peritoneum being detached from the wall of the pelvis, scrape away a large quantity of fat with the handle of the scalpel. The fascia will now be seen as low as the situation of the piece of the membrane that is prolonged to the viscera, whilst the part of the fascia below the origin of the visceral layer has been seen in the examination of the perinæum; but if the perinæum has not

Steps to define the pelvic fascia.

been dissected, raise the lower aperture of the pelvis, and take the fat from the ischio-rectal fossa. If the scalpel is pushed upwards in the fossa, it will pierce the visceral layer (recto-vesical) close to its origin, and will mark the position of the levator ani muscle between the pelvic and recto-vesical fasciæ.

Fascia of the wall of the pelvis. The *pelvic fascia* is a thin membrane that is in close contact with the obturator muscle, and is fixed to the bone around its circumference, so that it might be called the special fascia (obturator) of that muscle. Its attachment around the obturator muscle; Superiorly its attachment to bone is determined by the extent of the muscle. Thus it reaches the brim of the pelvis for a short distance at the lateral aspect of the cavity; but in front of this it quits the brim, and still following the muscle forms an arch below the obturator vessels; and from the last spot inwards it is fixed along an oblique line that reaches to the lower part of the symphysis pubis. Inferiorly the fascia is attached to the margin of the great sacro-sciatic ligament, and to the rami of the ischium and pubes; but below the pubic arch it is continued from one bone to the other for a certain distance, partly closes aperture of pelvis in front; so as to join the recto-vesical piece at that spot, and to close the cavity of the pelvis in that direction. At a certain level, that of a line prolonged from the lower part of the symphysis pubis to the spine of the ischium, the fascia sends inwards gives off recto-vesical piece. the recto-vesical layer to the viscera of the pelvis; the origin of this offset is indicated by a whitish band, which marks the attachment of the levator ani muscle beneath. Connections of the fascia. The outer surface of the fascia is in contact with the obturator muscle. The inner surface, above the origin of the recto-vesical fascia, is in the cavity of the pelvis, but below that spot it enters into the ischio-rectal fossa. At the posterior border of the obturator muscle a thin membrane is continued backwards to the front of the sacrum, over the sacral plexus and the pyriformis muscle, but beneath the vessels by which it is perforated.

Different terms applied to the fascia. It may here be remarked that the term "pelvic" is not applied always, as in the previous description, to the fascia in its whole extent from the brim to the outlet of the pelvis, but that the name "obturator" is given to the part of it below the recto-vesical piece. Those who make this distinction describe the pelvic fascia

as dividing into obturator and recto-vesical layers at the level of the line mentioned.

Recto-vesical layer after.

The *recto-vesical fascia* may be seen extending from the wall of the pelvis to the viscera; but it will be better examined after the innominate bone has been taken away for the purpose of obtaining a side view of the pelvis.

How to remove the innominate bone.

Dissection.—To obtain a side view of the pelvis it will be necessary to separate one innominate bone, say the left. Detach then the pelvic fascia from the same side of the pelvis, separating it carefully from the obturator muscle, but without destroying the attachments of the white band of the fascia both before and behind. Saw through the innominate bone in front external to the symphysis, and afterwards saw through the lateral part of the sacrum. Cut off with a bone forceps the spine of the ischium with the pelvic fascia attached to it, and then take away the rest of the innominate bone by cutting through the pyriformis muscle and the vessels and nerves accompanying it through the sacro-ischiatic notch.

Preparation of the parts.

Place now a small block beneath the pelvis; partly distend the bladder, and introduce tow into the rectum or into the vagina of the female, as well as a small piece into the pouch of the peritoneum between the bladder and the rectum. If the bladder is empty half fill it with air. After the viscera are thus made prominent, the surfaces of the levator ani and coccygeus muscles are to be cleaned by taking away the cellular membrane from them. In this proceeding the recto-vesical fascia and the spine of the ischium should be raised with hooks.

Outlet of pelvis is closed by pyriformis, by coccygeus, and sacro-sciatic ligaments, with vessels and nerves; by levator ani,

Parts closing the outlet of the pelvis.—In addition to the recto-vesical fascia, the following parts assist to fill the large outlet of the pelvis that remains in the dried bones. Beginning behind, the student will first meet the pyriformis muscle, with the gluteal artery and nerve above it. Next comes the coccygeus muscle, with the sacro-sciatic ligaments stretched between the spine of the ischium and the coccyx, one border of the muscle reaching towards the pyriformis, and the other to the levator ani; and between its posterior border and the pyriformis are placed the sacral plexus of nerves and the sciatic and pudic vessels. The greater part of the rest of the space is closed by the levator ani, which extends from the coccygeus and the spine of the ischium, to the posterior part of the symphysis pubis, and meets its

and by pelvic fascia below the pubes. fellow inferiorly; but as the anterior fibres of opposite muscles are separated by the urethra and the prostate gland, the interval between them is closed by the fascia lining the pelvis.

Coccygeus; origin The COCCYGEUS MUSCLE is flat and triangular, and assists to close the outlet of the pelvis. It *arises* by a narrow part from the spine of the ischium, and some fibres are attached to the small sacro-sciatic ligament. Widening as it passes and insertion. inwards, the muscle is *inserted* into the side of the coccyx Connections of surfaces and into the lower part of the sacrum. The inner surface looks to the pelvis, and is in contact with the rectum; the opposite surface rests on the small sacro-sciatic ligament. and borders. The posterior border is contiguous to the pyriformis muscle, only vessels and nerves intervening, and the anterior or lower border is parallel to the levator ani muscle.

Levator ani; situation. The LEVATOR ANI is a thin flat muscle, which is situate in the angular interval between the pelvic and the recto-vesical fascia, and descends to support the viscera of the pelvis by joining below them with the muscle of the opposite side. It Origin partly bony, and partly membranous. *arises* anteriorly by fleshy fibres from an oblique line on the posterior aspect of the pubes, and posteriorly from the inner surface of the spine of the ischium; but between those two points of bone the muscle takes origin from the under part of the recto-vesical fascia, along the line of the white band before alluded to. All the fibres are directed downwards to Insertion along middle line of the perinæum. the middle line of the body, to be *inserted* after the following manner:—The anterior are the longest, and descend by the side of the prostate to join, anterior to the rectum, with the muscle of the opposite side in the central point of the perinæum; the middle fibres are inserted into the side of the rectum; whilst the posterior meet the opposite muscle behind the gut, and are also attached to the side of the coccyx, as before described in the dissection of the perinæum Borders and surfaces. (p. 398.) The anterior fibres of the levator are in contact with the fascia that closes the arch of the pubes, and the posterior are parallel to the coccygeus muscle. The upper surface is contiguous to the recto-vesical fascia, and the viscera of the pelvis; and the outer surface looks to the perinæum (ischio-rectal fossa). The two muscles, by their union,

form a fleshy layer across the outlet of the pelvis, similar to that (diaphragm) which separates the abdomen from the chest. This partition is convex below and concave above, and gives passage to the rectum, and in the female to the vagina; in front there is also an interval between the most anterior fibres, which allows the urethra to pass from the pelvis.

Two muscles form a fleshy diaphragm.

The anterior part of the muscle which descends by the side of the prostate, and unites with its fellow below the membranous part of the urethra, thus supporting that canal as in a sling, has been named *levator seu compressor prostatæ*.

Anterior fibres named levator prostatæ.

Dissection. — Detach the fleshy fibres of the levator ani at their origin, also the coccygeus muscle from the spine of the ischium, and throw both downwards, so as to leave uncut the recto-vesical fascia and its reflections on the viscera. The fascia will now be seen to be connected to the side of the bladder and rectum, and to give sheaths to those viscera below the spot at which it reaches them. To demonstrate these sheaths make one incision along the prostate, and another along the lower part of the rectum below the attachment of the fascia, and separate the membranous covering from each viscus.

Dissection for the recto-vesical fascia.

The *recto-vesical fascia* is derived from the pelvic fascia, and supports and partly invests the viscera of the pelvis. Arising, as before said, on a level with a band that extends from the pubes to the spine of the ischium, the fascia is directed inwards on the levator ani, and has the following disposition on the viscera: — In the middle line in front, it is continued from the back of the pubes to the upper surface of the prostate; here it closes the pelvis before the levatores ani, and forms on each side of the middle line a roundish band, named the anterior ligament of the bladder. More to the side, the fascia is attached to the lateral part of the prostate and to the side of the bladder, giving rise to the lateral vesical ligament; and still farther back it reaches the side of the rectum. The fascia, however, does not cease where it meets the viscera by becoming blended with their coats, but is continued downwards around the prostate and the rectum, so as to form sheaths for them. The tube that is prolonged on the gut becomes thin and cellular towards the anus;

Recto-vesical fascia arises from pelvic fascia, and is reflected on to the viscera supporting them.

It gives sheaths to the prostate and rectum,

whilst that on the prostate is separated from its viscus by a plexus of veins (prostatic), and has an offset directed backwards to incase the vesiculæ seminales. The recto-vesical fasciæ of opposite sides form a partition, like the levatores ani muscles, across the pelvis, which is perforated by the prostate and the rectum; but in the case of the fascia the viscera receive sheaths from the membrane as they pass through it.

and forms part of the floor of the pelvis.

Fascia in the female.

In the female the fascia has much the same arrangement as in the male; but the vagina, instead of the prostate, receives a tube of membrane after perforating it.

Pieces of the fascia

The *true ligaments of the bladder* are two on each side, anterior and lateral, and are derived from the recto-vesical fascia.

form the anterior

a. The *anterior* is a fold of the fascia that reaches from the posterior aspect of the pubes to the upper surface of the prostate, and to the neck of the bladder. It is a narrow white band, and encloses some muscular fibres of the bladder. Between the ligaments of opposite sides the recto-vesical fascia dips down to reach the prostate.

and lateral ligaments of the bladder.

b. The *lateral ligament* is but a piece of the same fascia, that is fixed, as before said, to the lateral part of the prostate gland, at its upper border, and to the side of the bladder on the same level.

False ligaments of bladder.

There are other ligaments of the bladder (false ligaments), which are derived from the peritoneum investing it, and will be seen in the following section.

SECTION II.

CONNECTIONS OF THE VISCERA IN THE MALE.

Dissection of female pelvis.

If the student should be dissecting a female pelvis, he will find the description of it farther on at page 547.

Contents of the pelvis.

The viscera in the pelvis have been already specified to be the lower end of the large intestine (rectum), together with the bladder and part of the generative organs. Most posterior of all is the rectum, which takes a curved course with

the convexity backwards, and receives into its concavity the bladder, with the prostate and the vesiculæ seminales. These organs are partly surrounded by the peritoneum. Outline of their position.

Dissection. — To expose the viscera take away from them the recto-vesical fascia, except the anterior ligament of the bladder. Follow forwards from the back of the pelvis to the bladder the obliterated remains of the internal iliac artery (hypogastric), and remove the other branches of the same artery to the lower limb. When the fat and vessels are cleared away, the pouch of the peritoneum, in which wool has been placed, is brought into view, with the ureter passing to the bladder. Now clean the prostate, and define the vesiculæ seminales which are behind it. Clean at the same time the part of the bladder below the peritoneum, and follow downwards the vas deferens which lies on the lateral aspect of that viscus. Lastly, remove the cellular layer from the lower part of the rectum, viz. the part below the peritoneum, but preserve the branches to it from the inferior mesenteric artery. If the bladder is flaccid half fill it with air, in order that its connections may be studied. The several viscera are to be cleaned.

The *peritoneum* does not envelop the viscera of the pelvis so completely as those of the upper part of the abdomen. After partly surrounding the upper portion of the rectum, and fixing it by a process, *meso-rectum*, the membrane can be traced to the back of the bladder, where it projects for some way between this viscus and the rectum, forming the recto-vesical pouch. On each side of the rectum the serous membrane is arrested by the internal iliac-artery, and gives rise to a fold, posterior ligament of the bladder. Tracing the peritoneum upwards on the bladder, the student will find it cover all the posterior aspect, and the posterior part of each lateral region as far forwards as the position of the obliterated hypogastric artery, but at that vessel it is reflected from the sides and summit of the bladder to the wall of the pelvis and abdomen. All the anterior surface is therefore uncovered by peritoneum; and when the bladder is distended it rises above the pubes so as to allow of its being opened at this aspect without risk of injury to the serous membrane. The peritoneum covers partly the rectum and partly the bladder, leaving front and lower part uncovered.

The *recto-vesical pouch* is wide behind, where it corresponds to the interval between the iliac arteries, and is narrow in front be- The pouch between

the rectum and bladder. Extent forwards and distance from the anus vary.

tween the rectum and the bladder. Anteriorly it extends as far as, or even into the interval between the vesiculæ seminales, and ends usually about one inch and a half from the tip of the coccyx, but sometimes it reaches the prostate gland. The distance of the pouch from the anus is commonly about four inches; but this will vary with the state of the bladder, for if this viscus is distended the pouch of the peritoneum is raised with it, and is therefore removed farther from the end of the intestine.

Folds of it, false ligaments of the bladder, viz.—

Ligaments of the bladder. — Where the peritoneum is reflected from the bladder to the wall of the cavity, it gives rise to the false ligaments of that viscus. These are five in number: — two posterior, two lateral, and one superior.

two posterior,

The *posterior* ligament (one on each side) reaches from the back of the pelvis to the bladder, and contains the obliterated hypogastric artery, the ureter, and some vessels and nerves. Between these is the hollow of the recto-vesical pouch.

two lateral,

The *lateral ligament*, also one on a side, is a wide piece of peritoneum, that is reflected from the side of the bladder to the iliac fossa and the wall of the pelvis. Along its line of attachment to the bladder is the obliterated hypogastric artery.

and one superior.

The *superior ligament* is reflected from the upper part of the bladder to the abdominal wall along the same obliterated vessel.

Extent of the rectum,

The RECTUM, or the lower part of the great intestine, extends from the junction between the sacrum and ilium to the anus, and is kept in place by the peritoneum and the recto-vesical fascia. The intestine is about eight inches long, and takes a winding course, for it follows the curve of the sacrum and coccyx; it is divided into three parts, upper, middle, and lower.

length, and divisions.

First piece most covered by peritoneum.

The *upper part*, longer than the others, extends obliquely from the junction of the sacrum and ilium to the centre of the third piece of the sacrum. It is surrounded almost entirely by the peritoneum which forms the meso-rectum behind it; and it lies on the sacrum, and on the pyriformis muscle and the sacral plexus of the left side. In contact with its left side are the branches of the internal iliac artery and the left ureter. In some bodies this part of the intestine is much curved to the right side.

Middle piece

The *middle piece* lies beneath the bladder, and reaches to

the tip of the coccyx: it is about three inches in length, and is covered by peritoneum on the upper aspect, but only for about two thirds of its extent. Resting on it is the lower or triangular part of the bladder, with the vesiculæ seminales and the prostate gland; and behind it is only the bone. On the side is the coccygeus muscle. only covered in front.

The *lower part* is about an inch and a half in length, and is curved from the tip of the coccyx to the anus: at first it is much dilated, but at the anus it is contracted. This part of the intestine is without peritoneal covering, and is supported by the lower part of the triangular ligament of the urethra, and by the levatores ani muscles. Above the lower end of the rectum (in this position of the body) are the prostate, the membranous part of the urethra, and the bulb of the corpus spongiosum; but as the gut gradually recedes from the urethra, an angular interval is left between the two. The levatores ani muscles descend on its sides, and unite beneath it, supporting it in a sling, and the sphincter muscles surround the lower end. Sometimes this end of the intestine is very much enlarged, especially in women or old men, and rises up on each side of the prostate, so as to surround it except above. Last piece is uncovered. Connections with parts around. Sometimes dilated.

The URINARY BLADDER (vesica urinaria) is situate in the pelvis, and is the receptacle for the urine secreted by the kidneys. When the bladder is contracted it is of a triangular form, and lies within the pelvis against the anterior wall of the cavity. But when it is distended it becomes of a conical shape, with the larger part directed towards the rectum and the apex to the abdominal wall, and is slightly curved over the anterior part of the pelvis as it projects beyond it. If a line through its centre were prolonged, it would touch the abdominal wall somewhere (according to the distension) between the umbilicus and the pubes in the one direction, and the end of the coccyx in the other direction. The organ is maintained in its position by the recto-vesical fascia, and by the peritoneum, which form its ligaments. See pages 538. 540. Bladder is in pelvis when empty, and projects above when full. Axis.

For the purpose of studying its connections the bladder is Divisions.

divided into the following parts: viz. a summit and base, a body and neck.

Apex has cords on it. The *summit* or apex of the bladder is rounded, and from its anterior part three ligamentous cords are prolonged to the umbilicus: the central one of these is the remains of the urachus, and the two lateral are formed by the obliterated hypogastric arteries. If the bladder is full, the apex is above the pubes, but otherwise below it. All the part behind the obliterated vessels is covered by peritoneum.

Base alters in shape; parts in contact with it. The *base* (fundus) is large, and rests on the middle piece of the rectum. In the state of emptiness of the bladder the base is scarcely prominent; but in distension of the viscus, this part extends lower, and is flattened. Connected with the under part of the bladder are the vesiculæ seminales and the vasa deferentia, and between these is a triangular space from which the peritoneum is absent.

Surfaces anterior and posterior; lateral. *Surfaces of the body.* — The anterior part of the bladder is in contact with the posterior surface of the symphysis pubis, or with the lower part of the abdominal wall if it is distended, and is altogether free from peritoneum; whilst the posterior surface on the other hand is entirely covered by serous membrane. Each lateral region is crossed by the vas deferens, and extending along its upper part is the obliterated hypogastric vessel; near the lower part is seen the entrance of the ureter into the bladder. All the side of the bladder behind the obliterated vessel is covered by peritoneum, but the rest is uncovered.

Neck. The *neck* (cervix) is the narrow anterior part of the bladder that joins the urethra. It is surrounded by the prostate gland.

Position in pelvis varies with age. The position of the bladder in the pelvis is not the same in adult as in early life. For in the child (to the twelfth or the sixteenth year) this viscus projects above the brim of the pelvis into the hypogastric region of the abdomen, and the cervix is the lowest part. But in the adult the bladder is concealed by the larger pelvic bones, and the base or fundus projects inferiorly.

Ureter in pelvis, The *ureter* enters the posterior ligament of the bladder,

after crossing the common or the external iliac artery, and forms an arch below the level of the obliterated hypogastric vessel; it reaches forwards to enter into the bladder near the lower part, and somewhat on the side, or about two inches and a half from the prostate gland. and entrance into bladder.

The PROSTATE GLAND surrounds the neck of the bladder. It is placed below the level of the symphysis pubis, as well as posterior to it, and is supported by the rectum. Its shape is that of a cone with the base turned backwards, and its size equals a large horse chesnut. In this position of the pelvis, the direction of a line through the middle of the gland would be oblique downwards and backwards, though in the erect state of the body it would be almost horizontal. Position of the prostate; form; axis;

The *upper surface* is about three quarters of an inch below the symphysis pubis, and is connected to it by the anterior ligaments of the bladder. On this aspect are the dorsal veins of the penis. upper surface;

The *under surface* is of greatest extent, and is contiguous to the rectum; it is this part that is felt by the finger introduced into the bowel through the anus. under surface.

The *apex* touches the fascia of the pelvis that closes the interval between the rami of the pubes; and the base surrounds the vesiculæ seminales with the vasa deferentia, and limits anteriorly the triangular space at the base of the bladder. Apex and base.

The prostate is enveloped by a sheath obtained from the recto-vesical fascia (p. 537.), and a plexus of veins (prostatic) surrounds it. Through the middle of the gland the urethra takes its course to the penis; but this will be afterwards demonstrated. The size of the prostate alters much with increasing age, and in old people it may acquire a considerable magnitude. It is contained in a sheath; size may increase.

The VESICULÆ SEMINALES are two small elongated sacs, each about two inches long, between the under part of the bladder and the rectum. Each is pyramidal in form, and the larger end is turned backwards towards the ureter, whilst the smaller is surrounded by the prostate. Along the inner side is the vas deferens. At the prostate gland the vesiculæ Seminal vesicles; their connections.

are almost close together; but farther backwards they diverge, one from another, and enclose with the pouch of the peritoneum a triangular space at the under part of the bladder. The vesiculæ are contained in a membranous sheath, which is derived from the recto-vesical fascia.

Vas deferens; course unites with duct from vesicula.

The VAS DEFERENS or the excretory duct of the testis, in its course to the urethra, enters the abdomen by the internal abdominal ring, and is then directed inwards along the side and under part of the bladder to the base of the prostate, where it forms the common ejaculatory duct by joining with the duct from the vesicula. The position of this tube to the external iliac artery has been noticed; on the bladder it may now be seen to lie internal to the ureter, and internal to the vesicula of the same side. By the side of the vesicula the duct is much enlarged, and is sacculated.

The urethra; length; it is curved according to the condition of the penis; its divisions.

The URETHRA is the excretory passage for the urine and semen, and reaches from the bladder to the end of the penis. Its length varies from seven and a half to nine inches and a half, and it presents one or two curves according to the state of the penis. At first the canal is directed forwards through the triangular ligament of the perinæum, and next upwards to the body of the penis, forming a large curve with the concavity to the pubes. Thence to its termination the urethra is applied to the penis, and whilst this body remains pendent, it forms a second bend with the concavity downwards; but if the penis is raised, the canal makes but one curve throughout. The canal is divided into three parts, prostatic, membranous, and spongy.

Prostatic,

The *prostatic part* is contained in the prostate gland, and receives its name from that circumstance. Its length and connections are the same as those of the gland (p. 543.).

membranous,

The *membranous part* is nearly an inch long, and intervenes between the apex of the prostate and the front of the triangular ligament. It is somewhat curved upwards, and the bulb of the corpus spongiosum is directed backwards below it, so that the under part appears to measure less than the upper. Surrounding it are the muscular fibres of the

constrictor urethræ, and close below are Cowper's glands; beneath it is the rectum. This division of the urethra is the least supported and the weakest.

The *spongy part* is surrounded by the corpus spongiosum urethræ, and ends at the extremity of the penis, in the orifice in the glans (meatus urinarius). It is the longest part of the urethra, and measures about six inches. At its commencement this division of the excretory canal is surrounded by the ejaculator urinæ muscle. and spongy.

Dissection.—If the penis is not sufficiently dissected to see its form, let the student clean away its cellular covering. The spongy part of the urethra will also be better seen when that is done. Dissection.

The PENIS is a cylindrical body which is attached to the front of the pubes, and depends therefrom in front of the scrotum. It consists of a firm fibrous mass (corpora cavernosa) that forms the principal part of the organ; of a soft spongy substance that surrounds the urethra (corpus spongiosum), and forms the head, or the glans penis; and of an integumentary investment for the whole, together with vessels and nerves. Constituents and situation of the penis.

The *integumentary* covering is continued from that of the abdomen, but the fat that is present in the superficial fascia in other parts is absent from this investing the penis. Around the end of the penis it forms the loose sheath of the prepuce, which is constructed by two layers in the following way: — at the end of the penis the skin is reflected backwards as far as around the base of the glans, constituting thus the prepuce; but it is afterwards continued over the glans, and joins the mucous membrane of the urethra at the orifice on the surface. At the under part of the glans, and behind the aperture of the urethra, the integument forms a small triangular fold, *frænum preputii.* Where the integument covers the glans it is very thin, and in some cases assumes the character of a mucous membrane; and behind the glans are some small sebaceous follicles — *glandulæ odoriferæ.* A covering of integument forms prepuce and frænum. Sebaceous glands.

The *corpora cavernosa* form the bulk of the penis, and are two dense, fibrous, almost cylindrical tubes, which are Corpora cavernosa

form body of penis, filled with vascular structure. Each is fixed posteriorly to the rami of the ischium and os pubis by a thick pointed process, the *crus penis;* but after a distance of an inch and a half it becomes blended with its fellow in the body of the penis.

but each is separate behind. The *body* of the penis thus constructed is grooved above and below along the middle line, and presents anteriorly a narrowed but truncated extremity that is covered by the glans penis; along its under surface the urethra is conducted.

Form and attachment of penis. Besides the attachment of the corpora cavernosa by the crura, the body of the penis is connected with the front of the symphysis pubis by its suspensory ligament.

Corpus spongiosum The *corpus spongiosum urethræ* encloses the urethral canal, and forms the head of the penis. It is a vascular and erectile structure, like the corpus cavernosum, but is much less strong.

surrounds urethra, and swells into Commencing posteriorly by a dilated part — the bulb, this structure extends forwards around the urethra to the extremity of the penis, where it swells out into the conical glans penis.

the bulb, The *bulb* is in front of the triangular ligament of the urethra, and opposite the junction of the crura of the corpora cavernosa. It is directed backwards slightly below the membranous part of the urethra, and is fixed by fibrous tissue to the front of the triangular ligament.

which is lobed, The accelerator urinæ muscle covers it; and the enlargement usually presents a central constriction, with a bulging on each side, that marks its subdivision into two lobes.

and the conical glans penis. The *glans penis* is a somewhat conical mass, which covers the blunt end of the corpus cavernosum. Its base is directed backwards, and is marked by a slightly prominent border — *corona glandis*, which is sloped obliquely along the under aspect, from the apex to the base. In the apex is a vertical slit, in which the urethral canal terminates, and below that aperture is an excavation that contains the frænum preputii.

Section III.

CONNECTIONS OF THE VISCERA IN THE FEMALE.

In the pelvis of the female is contained the lower end of the intestinal tube, with the bladder and the urethra as in the male; but there are in addition the uterus, with its accessories, and the vagina. The rectum is most posterior, and the uterus and vagina lie in the concavity of its bend. The bladder and urethra are altogether in front of the other parts. In this sex there are three tubes connected with the viscera that are directed forwards, one above another, to the surface, viz. the tube of the rectum, that of the vagina, and that of the urethra.

Contents of the female pelvis, and their situation.

Directions for removing the innominate bone are given with the dissection of the male pelvis, and the student should use the description in Section I. (p. 533.) to learn the fasciæ and the muscles of the pelvis, that are common to both sexes, before he makes the special dissection of the viscera of the female pelvis, as below.

Use description of male pelvis.

Dissection.— On taking away the recto-vesical fascia and some cellular membrane, the several viscera will come into view. To maintain the position of the uterus it should be held up with a piece of string passed through the upper part. The reflections of the peritoneum on the viscera are to be preserved, and a piece of cotton wool is to be placed between the rectum and uterus. The obliterated part of the internal iliac artery is to be followed forwards to the bladder, but all the other branches may be cut away on this the left side; the ureter will be found passing to the bladder close to that artery. Afterwards clean, and partly separate the urethra, the vagina, and the rectum at the anterior part of the pelvis, but preserve the arteries on the rectum.

Then clean the viscera of the female pelvis.

The *peritoneum* partly covers the viscera, as in the male. Investing the upper part of the rectum, and forming behind it the meso-rectum, the membrane is continued for a short distance on the front of the intestine to the posterior part of the vagina, and to the back of the uterus. It covers the posterior, and the greater part of the anterior aspect of the

Reflections of the peritoneum.

uterus, and can be traced to the bladder without again touching the vagina. On each side of the uterus it forms a wide fold (broad ligament), which attaches that viscus to the wall of the abdomen and pelvis. As the peritoneum is followed upwards to the wall of the abdomen, it will be found to cover the posterior aspect of the bladder, but only a part of each lateral aspect, viz. that behind the position of the obliterated hypogastric artery. In the female, the pouch corresponding to that in the male between the rectum and bladder, can scarcely be said to exist, because the vagina intervenes between the two, and arrests, so to speak, the passing forwards of the peritoneum. In the pelvis the serous membrane forms the following ligaments:—

Folds or ligaments are —

broad ligament of the uterus,

The *broad ligament of the uterus* passes from the side of the uterus to the wall of the abdomen, and supports this organ in the cavity of the pelvis. By its position across the pelvis it divides the cavity into an anterior and a posterior part; in the former are placed the bladder, urethra, and vagina; in the latter the upper part of the rectum, and the small intestines when they reach the pelvis. Each ligament shows traces of a subdivision into three pieces, corresponding to the parts contained between its two layers; thus there is a posterior piece that belongs to the ovary and its ligament; an anterior, near the upper part, which is appropriated to the round ligament; and a middle piece, the highest of all, that surrounds the Fallopian tube. It is at the free extremity of the Fallopian tube that the peritoneum is continuous with the mucous membrane.

that is subdivided into three parts;

and anterior ligament.

Between the neck of the uterus and the back of the bladder is a small fold on each side, which is sometimes described as a ligament (anterior ligament) of the uterus.

Five ligaments of the bladder.

The *ligaments of the bladder* (false ligaments) are the same as in the male, and are five in number, two posterior, two lateral, and a superior: they are all blended in one large piece of peritoneum reaching from the bladder to the side and front of the pelvis. In the female the posterior ligament containing the ureter and the vessels of the bladder is less marked than in the male, because the uterus intervenes and pushes aside the vessels.

Connections of the rectum, viz.

The RECTUM is not so curved in the female as in the male, and is generally larger. Descending along the middle of the

sacrum and coccyx to the anus, the intestine is divided into three parts: —

The *first part* extends to the third piece of the sacrum, and is enveloped by the peritoneum, except posteriorly: its connexions are the same as in the male. of upper,

The *middle part* reaches to the tip of the coccyx, and has the vagina above and in contact with it. The peritoneum covers the front for a short distance. middle,

The *lower part* curves to the anus away from the vagina, so as to leave a space between the two which corresponds on the surface to the part of the perinæum between the anus and the vulva. The levatores ani are on each side, and unite below it. and lower part.

The UTERUS is somewhat of a conical shape, flattened from before backwards, with the wider end placed upwards, and the lower end communicating with the vagina. It is situate in the pelvis, between the bladder and rectum, and is retained in place by the broad ligaments. Unless enlarged, it is below the brim of the pelvis. This viscus is tilted forwards, so that its position is oblique in the cavity of the pelvis, and a line through the centre of the organ would correspond to the axis of the inlet of the pelvic cavity, but not to that of the vagina. Form and situation. Position to the brim of pelvis Axis.

The *anterior surface* is covered by peritoneum, except in the lower fourth, where it is in contact with the under part of the bladder, and is connected to it by cellular membrane. The *posterior surface* is altogether invested by the serous membrane. Surfaces.

The *upper end* (fundus vel basis uteri) is the largest part of the organ, and is in contact with the small intestines. The *lower end*, or the neck (cervix uteri) is received into the upper part of the vagina. Extremities.

To each *side* is attached the broad ligament which encloses the Fallopian tube, the round ligament, and the ovary. On the side are

a. The *Fallopian tube* is contained in the free border of the ligament, and is connected by the one end to the upper angle of the uterus, whilst the other is loose in the cavity of the pelvis. At its attachment to the uterus the tube is of Fallopian tube,

small size, but it increases towards the opposite end, where it is dilated like the end of a trumpet, and fringed (corpus fimbriatum).

round ligament

b. The *round* or suspensory *ligament* is a fibrous cord, that is directed outwards through the internal abdominal ring, and the inguinal canal, to the groin. This cord lies over the obliterated hypogastric, and the external iliac artery, and is surrounded by peritoneum, which accompanies it a short way into the canal.

and the ovary and its ligament.

c. The *ovary* is placed nearly horizontally, bulging at the posterior aspect of the broad ligament, and is connected to the uterus at the inner end by a special fibrous band, *ligament* of the ovary. Its form is oval, and its margins are turned forwards and backwards. Its size is very variable.

Extent and form; length; axis; connections.

The VAGINA is the tube between the uterus and the exterior of the body. It is somewhat cylindrical in shape, though flattened on the front and back. Its length is from four to five inches. The vagina is slightly curved as it follows the bend of the rectum, and its axis therefore corresponds at first to that of the outlet of the pelvis, but higher up to the axis of the cavity of the pelvis. In front the vagina is in contact with the base of the bladder, and with the urethra; and beneath or below it is the rectum. To the side is attached the recto-vesical fascia, which sends a sheath along the lower part of the tube. The upper end receives the neck of the uterus by an aperture in the anterior or upper wall; and the lower end is the narrowest part of the canal, and is surrounded by the sphincter vaginæ muscle. In children, and in the virgin, the external aperture is closed by the hymen. The vagina is surrounded by a large plexus of veins.

Lower end closed sometimes.

Bladder resembles that of the male.

The BLADDER is placed at the anterior part of the pelvis, above the vagina, and in contact with the back of the pubes. Its form, position, and connections, so closely approach those of the bladder in the male body, as to render it unnecessary to repeat them again here (see p. 541.). The chief differences in the bladder of the two sexes are the following: —

Differences

In the female the bladder is larger than in the male, and

its transverse exceeds its vertical measurement. The base is of less extent; it is in contact with the vagina and the lower part of the uterus; but it does not project below the level of the urethra, so as to form a pouch as in the male. On the side of the viscus there is not any vas deferens, and the prostate is absent from the neck. between in the two sexes.

The *ureter* has a longer course in the pelvis of the female than in that of the male before it reaches the bladder. After crossing the internal iliac vessels it passes by the neck of the uterus ere it arrives at its destination. Course of ureter.

The *urethra* is a small narrow tube about one inch and a half long, which curves slightly below the symphysis pubis, the concavity being upwards. Its situation is above the vagina, and its external opening is placed within the vulva. In its course to the surface it is imbedded in the tissue of the vaginal wall, and perforates the triangular ligament of the perinæum, but before reaching the last structure it is surrounded by muscular fibres (constrictor urethræ, p. 412.). A plexus of veins surrounds the urethra as well as the vagina. Urethra; length and form; connections with parts around.

Section IV.

VESSELS AND NERVES OF THE PELVIS.

This section is to be used by the dissectors of both the male and female pelvis.

In the pelvis are the internal iliac vessels and their branches to the viscera; the sacral nerves and the sacral plexus; and the sympathetic nerve, consisting both of a gangliated cord, and of offsets of the hypogastric plexus. Vessels and nerves of the pelvis.

Dissection. — The internal iliac vessels are to be dissected on the opposite side, the right. Let now the air escape from the bladder, and draw it and the rectum, together with the uterus and vagina in the female, from their situation in the centre of the pelvis. Remove the peritoneum and cellular membrane from the viscera and from the trunks of the vessels, and follow onwards the branches that leave the pelvis or supply the viscera; the obliterated cord of the artery is to be traced on the bladder to the umbilicus. To dissect the vessels of the pelvis.

Nerves. With the vessels are offsets of the hypogastric plexus of nerves, but in the present state of the body these will probably not be seen; and in dissecting the vessels to the bladder and rectum branches of the sacral spinal nerves will come into view. The veins in a general dissection may be removed to make clean the arteries. When the vessels are quite prepared the bladder may be again distended, and the viscera replaced.

Veins.

Destination of the artery; The INTERNAL ILIAC ARTERY is one of the trunks resulting from the division of the common iliac artery, and furnishes branches to the viscera of the pelvis, to the generative organs, and to the thigh.

size and length; In the adult the vessel is a short trunk, of large capacity, which measures about an inch and a half in length. Directed downwards, as far as the sacro-sciatic notch, the artery terminates in two large trunks, from which the several branches are furnished. From its extremity a partly obliterated vessel (obliterated hypogastric) extends forwards to the bladder. In entering the pelvis the artery lies in front of the lumbo-sacral nerve and the pyriformis muscle, and is contained in the fold of peritoneum that forms the posterior ligament of the bladder. It is accompanied by the internal iliac vein, which is posterior to it, and somewhat on the outer part on the right side.

termination; position of vein; connections.

Branches. The *branches* of the artery are numerous, and arise from the large trunks of the internal iliac usually in the following manner: — from the posterior trunk arise the ilio-lumbar, lateral sacral, and gluteal branches; and from the anterior trunk come the vesical (upper and lower) obturator, sciatic, and pudic, and, in the female, the uterine and vaginal branches.

Trunk varies in length, *Peculiarities.* — The length of the internal iliac varies from half an inch to three inches, its extreme measurements, but in two thirds of a certain number of instances (Quain) it ranged from an inch to an inch and a half. The increased length of the internal iliac is dependent upon the shortening of the common iliac artery. The ending of the vessel may be at any spot between the usual place of origin and termination.

and in the spot at which it ends.

Condition of the artery in the fetus, In the fetus the internal iliac becomes the *hypogastric artery*, and leaves the abdomen by the umbilicus. Larger than the external iliac artery, and entering but slightly into the cavity of the

pelvis, the vessel is directed forwards to the back of the bladder, and then upwards along the side of that viscus to its apex. Beyond the bladder the vessel ascends along the posterior aspect of the abdominal wall with the urachus, and converges to its fellow, to reach the umbilicus. Here the vessels of opposite sides come into contact with the umbilical vein, and passing from the abdomen through the aperture in that spot, enter into the placental cord, and receive the name *umbilical*. In the fetus, as in the adult, the same branches are furnished by the artery, though the relative size at the two periods is very different.

When uterine life has ceased the hypogastric artery diminishes in consequence of the arrest of the current of blood through it, and finally becomes obliterated more or less completely as far back as to an inch and a half of its commencement, only a cord remaining in the position of the former vessel; commonly, however, the cord is pervious by means of a very small canal as far as the upper part of the bladder, and gives origin to the vesical arteries.

and its transformation into that of the adult.

The branches arising from the posterior part of the internal iliac, are, ilio-lumbar, lateral sacral, and gluteal.

Branches of the posterior trunk.

1. The *ilio-lumbar branch* passes outwards beneath the psoas muscle and obturator nerve, but in front of the lumbosacral nerve, and divides into an ascending and a transverse branch in the iliac fossa.

Ilio-lumbar has an

a. The ascending or *lumbar* offset which is beneath the psoas, supplies that muscle and the quadratus lumborum, and anastomoses with the last lumbar artery: it sends also a small *spinal* branch through the foramen between the sacrum and the last lumbar vertebra.

ascending and

b. The transverse or *iliac* part divides into branches that ramify in the iliacus muscle, some running over and some beneath it. At the crest of the ilium these branches anastomose with the lumbar and circumflex iliac arteries, and some twigs from the deep branches enter the innominate bone.

a transverse branch.

The *lateral sacral branches* are two in number, superior and inferior; they correspond in situation to the lumbar arteries, and form a chain of communication by the side of the apertures in the front of the sacrum. These branches supply the muscles (pyriformis and coccygeus), and anastomose with the preceding, as well as with the middle sacral branch. A small *spinal branch* enters the spinal canal through each

Lateral sacral arteries

supply spinal branch.

aperture in the sacrum. The upper of the two arteries is the largest.

Gluteal artery.

3. *The gluteal artery* is a short thick trunk, that appears to be the continuation of the posterior division of the internal iliac. Its destination is to the gluteal muscles on the dorsum of the innominate bone, and it is transmitted from the pelvis above the border of the pyriformis muscle, with its accompanying vein and the superior gluteal nerve.

Small offsets.

In the pelvis this artery gives small branches to the contiguous muscles (iliacus pyriformis and obturator), and a nutritious artery to the bone.

Branches of the anterior trunk.

The branches from the anterior division of the internal iliac artery are the following: —

Vesical arteries;

1. The *vesical arteries* are named superior and inferior, and are distributed to the upper and lower parts of the bladder.

three or four upper,

a. The *upper vesical* are three or four in number, and arise at intervals from the partly obliterated hypogastric trunk: the lowest is sometimes called middle vesical branch. Offsets are distributed from these branches to all the body and upper part of the bladder.

and a lower,

b. The *lower vesical* artery arises from the front of the internal iliac in common with a branch to the rectum, or with one to the vagina in the female. It is distributed to the base of the bladder, to the vesiculæ seminales, and to the prostate. A small offset from this artery, or from the upper vesical, is furnished to the vas deferens, and ascends on it as far as the inguinal canal.

with an offset to the rectum.

The *branch to the rectum* (middle hæmorrhoidal) is either supplied by the inferior vesical, as before said, or by the pudic. It ramifies on the anterior and lower part of the rectum, and on the vagina in the female, and anastomoses with the superior and inferior hæmorrhoidal arteries.

Obturator artery courses across pelvis.

2. The *obturator artery* is distributed outside the pelvis, and merely crosses this cavity to reach its aperture of exit. This branch springs usually from the anterior division of the internal iliac artery, and is directed forwards below the brim of the pelvis to the aperture in the upper part of the thyroid foramen. Passing from the pelvis by that opening, the artery ends in two branches that encircle the obturator foramen. In the pelvis the artery has its companion nerve

Offsets in pelvis;

above, and the vein below it, and it distributes the following small branches: —

a. Iliac branch. — Amongst other small offsets the obturator furnishes a twig to the iliac fossa to supply the bone and the iliacus muscle; this anastomoses with the ilio-lumbar artery. Iliac and

b. The *pubic branch*, arising as the artery is about to leave the pelvis, ascends on the posterior aspect of the pubes, and communicates with the corresponding branch of the opposite side, as well as with the offset sent downwards from the epigastric artery. There may be more than one branch to the pubes. pubic branch.

Peculiarities. — The obturator artery may arise at the front of the pelvis, from the epigastric instead of the internal iliac trunk, and turn down almost vertically to the thyroid aperture. Or it may arise by two roots, one from the epigastric, another from the internal iliac, the roots varying in size in different instances: thus they may be nearly equal in size, that from the internal iliac may be the larger of the two, or that from the epigastric may be the largest (Quain). The position of the obturator to the internal crural ring, in the instances of origin from the epigastric, has been before alluded to (p. 445). Its origin from epigastric, or iliac, or from both.

Further, the obturator may take origin from the external iliac artery. From external iliac.

The frequency with which these different peculiarities occur will be found in Mr. Quain's work on the "Anatomy of the Arteries." Suffice it to say here that the origin from the internal iliac is the most frequent, that from the epigastric next, and the origin from the two sources, or from the external iliac artery, the least frequent. Frequency of the different origins.

3. The *sciatic artery* is the next largest branch to the gluteal, and may be considered the offset by which the internal iliac artery terminates. The artery is continued over the pyriformis muscle and the sacral plexus to the lower part of the sacro-sciatic notch, where it leaves the pelvis between the pyriformis and coccygeus. External to the pelvis it divides into branches beneath the gluteus maximus muscle. In the pelvis it supplies the pyriformis and coccygeus muscles. Sciatic artery in the pelvis, and outside it.

4. The *pudic artery* has nearly the same connections in the pelvis as the sciatic, from which it often springs; escaping from the pelvis it ends in the perinæum and in the genital organs. If the artery arises by a separate trunk from the internal iliac, it accompanies the sciatic, though external to it, and leaves the pelvis between the pyriformis Pudic artery in the pelvis.

and coccygeus. At the back of the pelvis it winds over the spine of the ischium, and enters the perinæum. (See p. 407.)

Some small offsets. In the pelvic part of its course the artery gives some unimportant branches, and frequently the middle hæmorrhoidal branch arises from it.

When smaller than usual, an accessory branch comes from internal iliac. *Peculiarities.*—The pudic artery is sometimes smaller than usual, and fails to supply some of its ordinary branches, especially the last to the penis. In those cases the deficient branches are derived from an artery, *accessory pudic* (Quain), which takes origin mostly from the pudic inside the pelvis, and courses forwards by the side of the lower part of the bladder, and the upper part of the prostate gland, to leave the pelvis below the pubic arch. It furnishes branches to supply the place of those that are wanting.

Branches in the female. The branches of the internal iliac artery that are peculiar to the female are two, the uterine and vaginal.

Uterine artery 5. The *uterine artery* passes inwards between the layers of the broad ligament, to the neck of the uterus. At that part the vessel changes its direction, and ascends along the side of the uterus to the fundus, where it anastomoses with the ovarian artery (spermatic) of the aorta. Numerous supplies uterus. branches enter the substance of the uterus, ramifying in it, and anastomose with those of the opposite side. This artery and its branches are remarkable for their tortuous condition.

Offsets to vagina, *a.* At the neck of the uterus some small twigs are supplied to the vagina and bladder, and the special vaginal artery may arise from it at that spot.

and in the broad ligament. *b. Branches in the broad ligament.*—One branch accompanies the round ligament into the inguinal canal and anastomoses with a branch of the epigastric. Another extends on the Fallopian tube, and divides into long branches that reach the end. And a third, according to J. Webber, is distributed to the ovary.

Vaginal artery. 6. The *vaginal artery* seldom arises separately from the internal iliac. Combined with the preceding, or with the branch to the rectum, this artery extends to the vagina, and ramifies in its wall as low as the outer orifice.

Branches of the aorta. The remaining arteries in the pelvis that are not derived from the internal iliac are the ovarian, superior hæmorrhoidal, and middle sacral.

Ovarian artery. The *ovarian artery* has been described in part with the

branches of the aorta, and has been traced to the pelvis (p. 516.). After passing the brim of the pelvis it becomes tortuous, and enters the broad ligament to be distributed to the ovary. In the broad ligament there is a free anastomosis between the ovarian and uterine arteries.

The *superior hæmorrhoidal artery* is the continuation of the trunk of the inferior mesenteric behind the rectum, and divides into two branches opposite the middle of the sacrum. From the point of the division of the trunk these branches are continued along the rectum, one on each side, to the lower part of the gut, and anastomose with its other vessels, viz. the middle and inferior hæmorrhoidal arteries. Superior hæmorrhoidal.

The *middle sacral artery*, a small branch from the bifurcation of the aorta, descends along the middle line of the body, over the last lumbar vertebra, the sacrum, and coccyx, and terminates at the lower part of the spinal column, by anastomosing with the lateral sacral arteries. Middle sacral, which

In its course the artery gives small branches laterally opposite each vertebral element of the sacrum to anastomose with the lateral sacral arteries, and supply the nerves and the bones with their periosteum. Sometimes a small branch is furnished by it to the lower end of the rectum, which takes the place of the middle hæmorrhoidal artery. has these offsets.

The INTERNAL ILIAC VEIN receives the blood from the wall of the pelvis and from the pelvic viscera by branches corresponding for the most part to the arteries. The vein is a short and thick trunk, which is situate at first on the inner side of the internal iliac artery; but as it ascends to join with the external iliac it passes behind the artery, and on the right side reaches even the outer aspect of that vessel. Veins uniting in this trunk; position to its artery.

Some of the *branches* that form the trunk of the internal iliac vein, viz. the gluteal, obturator, and sciatic, have the same anatomy as the arteries; but the following branches, the pudic, vesical, uterine, and vaginal, have some peculiarities. Its branches that are peculiar are

The *pudic vein* receives roots corresponding to the branches of the artery, with the exception of the dorsal vein. Its hæmorrhoidal branch commences in a large plexus around pudic vein,

the lower end of the rectum (plexus hæmorrhoidalis) with which the superior hæmorrhoidal vein communicates.

dorsal vein of penis,

The *dorsal vein* of the penis receives vessels from the corpora cavernosa and corpus spongiosum, pierces the triangular ligament of the urethra, and divides into two, a right and left branch, which enter a plexus around the membranous part of the urethra and the prostate.

vesical,

The *vesical veins* commence in a plexus about the lower part of the bladder, that anastomoses with the prostatic and hæmorrhoidal veins.

uterine, and

The *uterine veins* are numerous, and form a plexus in and by the side of the uterus. This plexus inosculates above with the ovarian plexus, and below with one on the vagina.

vaginal veins.

The *vaginal veins* also surround the vagina with a large vascular plexus.

The other veins of the pelvis (ilio-lumbar, lateral sacral, and middle sacral) open into the common iliac vein.

Dissection of the nerves, of the pelvis

Dissection. — To dissect the nerves of the pelvis it will be necessary to detach the urethra from the arch of the pubes. Next, the recto-vesical fascia and the levator ani, together with the vessels of the viscera, should be cut through on the right side, in order that the viscera may be drawn aside from the pelvis. If the bladder is distended let the air escape from it. The sacral nerves will be exposed as they issue from the sacral foramina; the dissector should follow the first four into the sacral plexus, and some branches from the fourth to the viscera. A branch of nerve (superior gluteal) arises from the lumbo-sacral cord as this passes to the sacral plexus. The last sacral and the coccygeal nerve are of small size, and will be found coming through the coccygeus muscle close to the coccyx; these are to be dissected with care. The student will best find these last nerves by tracing connecting filaments that pass from one to another, beginning with the offset from the fourth nerve.

sacral and coccygeal,

and sympathetic.

At the lower part of the rectum, bladder, and vagina is a large plexus of the sympathetic (pelvic plexus, Beck) which gives offsets to the viscera along the arteries. This plexus is generally destroyed in this stage of the dissection; but if it remains the student should trace the offsets from it, and its communicating branches with the spinal nerves.

Spinal sacral nerves.—The anterior divisions of the five sacral nerves decrease suddenly in size from above downwards; for whilst the first two are large trunks, the last two are small and slender. Issuing by the apertures in the front of the sacrum (the fifth nerve excepted), the nerves receive short filaments of communication from the gangliated cord of the sympathetic. The three first nerves, and part of the fourth enter the sacral plexus, but the fifth ends on the back of the coccyx. Sacral nerves are five; those that are peculiar are

The *fourth nerve* divides into two parts, as above stated: one communicates with the sacral plexus; the other distributes the following branches to the viscera and the surrounding muscles, and joins the fifth nerve. fourth, which gives

a. The *visceral branches* supply chiefly the bladder and the vagina, and communicate with the sympathetic nerve to form the pelvic plexus. Sometimes these branches come from the third sacral nerve. visceral

b. The *muscular branches* are three in number. One rather long branch enters the levator ani on its visceral aspect; another supplies the coccygeus; and the third reaches the perinæum by piercing the coccygeus muscle. (See page 399.) and muscular offsets;

The *fifth nerve* comes forwards from the lower end of the spinal canal through the coccygeus muscle. As soon as it appears in the pelvis it receives the communicating branch from the fourth nerve; the nerve is then directed downwards in front of the coccygeus, where it is joined by the coccygeal nerve, and perforates the muscle near the tip of the coccyx, to end on the posterior surface of that bone. fifth is below apertures in sacrum, ends on coccyx.

The *coccygeal nerve* (sixth sacral), after leaving the lower end of the spinal canal, appears through the coccygeus muscle, and joins the fifth sacral nerve. Coccygeal nerve.

Sacral Plexus.—This plexus is a large flat band, in which are united the lumbo sacral, and the first three sacral nerves, with part of the fourth sacral nerve. It is situate on the pyriformis muscle, and beneath the sciatic and pudic branches of the internal iliac artery. From the spot where the nerves join, the plexus becomes gradually smaller towards the lower end, and leaving the pelvis below the pyriformis, terminates in branches for the lower limb. Sacral plexus; situation and form.

Its branches to muscles inside the pelvis; one to obturator, two to pyriformis.

Most of the *branches* of the plexus arise outside the pelvis, and are distributed to the back of the lower limb. Only two internal muscles of the pelvis (pyriformis and obturator internus) receive their nerves from the sacral plexus.

The *nerve to the obturator internus muscle* arises from the part of the plexus resulting from the union of the lumbo-sacral with the first sacral nerve; it leaves the pelvis with the pudic artery, and winds over the spine of the ischium and through the small sacro-sciatic notch to enter the visceral surface of the muscle.

The *nerves to the pyriformis* are commonly two in number, and arise from separate parts of the plexus: they also enter the muscle at its visceral aspect.

Pudic nerve now seen at its origin.

The *pudic nerve*, like the artery of the same name, supplies the rectum, the perinæum, and the genital organs. The nerve arises at the lower part of the plexus as this is about to pass from the pelvis, and then accompanies its artery through the small sacro-sciatic notch to the perinæum. (See p. 408.)

Branches to the lower limb after.

The remaining branches of the plexus, viz. the small and great sciatic nerves, with small muscular offsets to the gemelli and quadratus femoris, are described with the lower limb. — See Dissection of the Buttock.

Superior gluteal nerve ends in gluteal muscles.

The *superior gluteal nerve* is a branch of the lumbo-sacral cord, and arises from it opposite the upper part of the large sacro-sciatic notch. It passes outwards above the pyriformis muscle to the back of the pelvis, where it ends in branches for the two smaller gluteal muscles.

Trace out the sympathetic.

Dissection. — Besides the large plexus of the sympathetic by the side of the bladder, the student will have to expose the part of the gangliated cord that lies in front of the sacrum. The several ganglia (three or four) and their branches will come into view after the cellular membrane is removed.

Sympathetic in the pelvis.

Sympathetic Nerve. — In the pelvis the sympathetic nerve consists of a gangliated cord (on each side) and of two lateral plexuses for the supply of the viscera.

The gangliated cord

A. The *gangliated cord* lies on the front of the sacrum and internal to the series of apertures in that bone. It is

continuous superiorly with the lumbar part of the cord by a single or double internodal piece; and inferiorly the cords of opposite sides converge, and are united in front of the coccyx by means of a loop, on which is situate a single median ganglion, *gang. impar.* Each cord is marked by ganglia at intervals, the number varying from three to five. From the ganglia branches of communication pass to the spinal nerves, and some filaments are directed inwards in front of the sacrum.

joins one of opposite side below, where there is a ganglion.

Offsets of the ganglia

a. The *connecting branches* are two to each ganglion, and are very short. Like the branches of the lumbar ganglia they may enter two sacral nerves instead of one.

to the spinal nerves;

b. The *internal branches* are smaller than those of other parts of the cord, and communicate in front of the sacrum and around the middle sacral artery with branches from the opposite side. From the first, or two first ganglia some filaments are furnished to the hypogastric plexus; and from the terminal connecting branches and the ganglion impar, in front of the coccyx, offsets descend over that bone.

to the hypogastric plexus and the viscera.

B. The *visceral* or *pelvic plexuses* (lateral inferior hypogastric) are two in number (right and left), and are derived mainly from the lateral prolongations of the hypogastric plexus (p. 463.). Each lateral part of the hypogastric plexus is continued downwards to the side of the bladder and rectum, or to the side of the vagina in the female, where it becomes united with offsets from the third and fourth sacral nerves, and constitutes the above-named plexus. Numerous ganglia are found in the plexus, especially at the points of union of the spinal and sympathetic nerves.

Plexuses of the sympathetic:

situation;

how formed.

From each plexus *offsets* are furnished to the viscera of the pelvis, and to the genital organs, along the branches of the internal iliac artery. These different secondary plexuses have the same name as the vessels on which they are placed; but as they may not be seen in the dissection, a mere enumeration of them will be sufficient.

Offsets to the viscera of the male, viz.—

1. The *inferior hæmorrhoidal plexus* is an offset to the rectum from the back of the pelvic plexus, and joins the sympathetic on the superior hæmorrhoidal artery.

to the rectum;

2. The *vesical plexus* contains large nerves and many spinal

to the bladder;

nerves, and passes forwards to the side and lower part of the bladder. It gives one offset to the vesicula seminalis, and another to the vas deferens.

to the prostate gland

3. The *prostatic plexus* leaves the lower part of the pelvic plexus and is distributed to the substance of the prostate gland. At the front of the prostate an offset of the nerves (cavernous) is continued onwards to the dorsum of the penis, to supply the cavernous structure. On the penis the cavernous nerves join the pudic nerve.

and the penis.

Offsets in the female:

In the female there are the following additional plexuses, for the supply of the viscera peculiar to that sex:—

to the ovary;

Ovarian plexus.—The principal nerves to the ovary are derived from the renal and aortic plexuses, and accompany the artery to that body; but the uterine nerves also supply some filaments to it.

to the vagina;

Vaginal plexus.—The nerves to the vagina are of large size, and are not plexiform, but consist in greater part of spinal nerve fibres: they end in the lower part of that tube.

and to the uterus.

The *uterine nerves* are furnished to the uterus without admixture with the spinal nerves. The nerves ascend along the side of the uterus, and are, for the most part, long slender filaments, without ganglia or communications until they terminate in the substance of the viscus. Some few nerves that surround the arteries are plexiform and ganglionic. — Beck.* The Fallopian tube receives its branches from the uterine nerves.

Chain of glands in pelvis;

The *lymphatic glands* of the pelvis form a chain in front of the sacrum and along the internal iliac artery. The efferent ducts of these bodies join the lumbar glands. Into these glands the deep lymphatics of the penis, and of the genital organs in the female, and the lymphatics of the viscera and wall of the pelvis, are collected.

lymphatics entering them.

* The distribution of the sympathetic nerve in the pelvis has been greatly certified by the excellent dissections of Mr. Beck. See Philosophical Transactions (Part II.) for 1846.

Section V.

ANATOMY OF THE VISCERA OF THE MALE.

The bladder and the parts at its base, viz. the vesiculæ seminales and the prostate gland, are to be taken first for examination.

Dissection.—To study the form and structure of the viscera it will be necessary to dislodge them from the cavity of the pelvis. In this step the student should carry the scalpel around the pelvic outlet, close to the osseous boundaries, so as to detach carefully the crura of the penis from the bones, and to divide the parts connected with the end of the rectum. After the viscera are removed, separate the rectum from the others, but leave together the bladder and the penis and urethra. Distend again the bladder, and dissect the peritoneum and cellular membrane from the muscular fibres. Clean afterwards the prostate and vesiculæ seminales, and follow the duct of the latter and the vas deferens into the gland. If any of the integument of the scrotum has been left attached to the penis it is to be removed, and the penis and urethra are to be made clean.

Take out the viscera.

Clean the bladder and prostate.

THE PROSTATE GLAND AND SEMINAL VESICLES.

Prostate Gland.—This is a firm glandular body that secretes a special fluid. It surrounds the neck of the bladder and the beginning of the urethra, but its connections with the surrounding parts have been enumerated (p. 543.).

Use and situation.

The gland is conical in form, with the base or larger end directed backwards, and is usually likened to a chesnut, which it much resembles. Its dimensions in different directions are the following: transversely at the base it measures about an inch and a half, from apex to base rather more than an inch, and in depth about three quarters of an inch or an inch; so that an incision directed obliquely downwards and outwards from the apex to the lateral part of the base of the gland, will be the longest that can be practised in this body. Its weight is about an ounce, but in this respect it varies greatly.

Form, dimensions, and weight.

Surfaces; base and sides.

On the upper surface the prostate is rounded, but a slight groove lies along the centre; and on the under surface, which is larger and flatter, there is a median hollow indicating its division into lobes. The posterior part, or the base is thick, and in its centre is an excavation which receives the common ejaculatory ducts. The sides are rounded, and are prolonged backwards beyond the notch in the base.

Three lobes; two lateral and a central.

Three lobes are described in the prostate, viz. a middle and two lateral, though there is little division of the glandular mass. The *lateral* lobes are similar on each side, and, forming the chief part of the gland, are prolonged back beyond the notch in the base. The *middle* lobe will be brought into view by detaching and throwing down the vesiculæ seminales and the ejaculatory ducts from the bladder: it is a small piece of the gland between the neck of the bladder and the ejaculatory ducts, which extends transversely between the lateral lobes. Oftentimes this middle lobe is enlarged in old people, and projects upwards into the bladder, so as to interfere with the flow of the urine from that viscus, or the passage of a catheter into it.

Gland contains three tubes.

The urethra and the two common ejaculatory ducts are contained in the substance of the gland: the former is transmitted through the gland from base to apex; and the latter perforate it obliquely to terminate in the urethral canal.

Appearance on a section.

On a section being made into the gland the mass appears reddish in colour; to the feel it is firm though lacerable; and it is enveloped by a thin fibrous covering that sends processes into the interior.

Structure. Ducts end in vesicles; on which are vessels.

Structure. — This gland resembles others in its general structure, but the excretory ducts are not united into one canal. On tracing inwards one of the ducts, after the urethra has been laid open, it will be found to divide as it sinks into the gland, and its final branches to give origin to small sessile vesicles, which are arranged around, and open into them. On the exterior of the vesicles and ducts the blood-vessels ramify; and lining the interior of the tubes is an epithelium of the columnar kind, which becomes pavemental in the vesicles. The ducts of the gland vary in number

from twelve to twenty, and open into the prostatic part of the urethra (p. 570.). Number of ducts.

Blood-vessels. — The *arteries* are unimportant, and are furnished by the vesical and hæmorrhoidal (p. 554.). The *veins* form a plexus around the gland, which communicates in front with the dorsal vein of the penis, and behind with a plexus of veins at the base of the bladder. In old men this vascular communication gives rise to considerable hæmorrhage when it is freely cut in the operation of lithotomy. Arteries. Veins form a plexus.

Vesiculæ Seminales. — These vesicles are two membranous, sacculated reservoirs for the secreted semen. They are placed on the under part of the bladder behind the prostate, and diverge from one another so as to limit laterally a triangular surface at this aspect of the viscus: their form and connections have been already described (p. 543.). Though sacculated behind, the vesicula becomes straight and somewhat narrowed in front; and at the base of the prostate it is blended with the vas deferens to form the common ejaculatory duct. Definition. Situation. Wavy sac.

The vesicula seminalis consists, like the epididymis, of a tube bent into a zigzag form, so as to produce lateral sacs or pouches, which are bound together by fibrous tissue; this cellular structure will be shown by means of a cut into it. When the bends of the vesicle are undone, its formative tube, which is about the size of a quill, measures from four to six inches, and ends posteriorly in a closed extremity. Connected with the tube, at intervals, are some lateral cæcal processes. Formed of a coiled tube. Length.

End of vas deferens. — Opposite the vesicula the vas deferens is increased in capacity, and is rather sacculated like the contiguous vesicle; but before it joins with the tube of that body to form the common ejaculatory duct, it diminishes in size, and becomes straight. End of vas deferens.

Structure. — The seminal vesicle has the same number of coats as the vas deferens (p. 513.), besides the case of the recto-vesical fascia. Its special elastic coat is formed of fibres that are supposed to be muscular. The mucous membrane is thrown into ridges by the bending of the tube, and presents an areolar or honeycomb appearance: it is lined Vesicle has a special and a mucous coat.

Vas deferens same. by a laminar epithelium. In the sacculated part of the vas deferens the mucous lining resembles in a slight degree that in the vesicula.

How formed. *Common seminal ducts.* — These tubes (right and left) are formed by the junction of the canal of one vesicula seminalis with the vas deferens of the same side, and convey Extent, the semen from its reservoir to the urethra. They begin opposite the base of the prostate, and are directed upwards course, and forwards through the glandular mass, and along the sides of a depression (sinus pocularis), to open within it, one on length, each side. Their length is rather less than an inch, and and termination. their course is convergent to their termination, where they are close together in the floor of the urethra (p. 570.).

Structure. *Structure.* — The wall of the common duct is thinner than that of the vas deferens, and in the prostate gland the special coat is almost wanting.

THE BLADDER.

Bladder out of the body. After the bladder has been separated from the surrounding parts, its form and the extent of its different regions can be more conveniently observed.

Form. Whilst it is in the body, the bladder is conical in shape, and is rather flattened from before backwards; but it is now more circular than when in its natural position, and has lost that arched form by which it adapts itself in distension to the Dimensions. axis of the pelvis. If this viscus is moderately dilated, it measures about five inches in length, and about three inches across (Hüschke). Its capacity is greatly influenced by the age and sex, and by the habits of the individual. Ordinarily the bladder holds about a pint, and as a general rule it is larger in the female than in the male.

Coats of the bladder. STRUCTURE. — A muscular and a mucous coat, with an intervening cellular layer, exist in the wall of the bladder: at parts the peritoneum may also be enumerated as a constituent of the wall. The vessels and nerves are large.

Peritoneal. The imperfect covering of *peritoneum* has been described (p. 539.), and has been removed.

The *muscular* coat is formed of two layers of unstriped muscular fibres, viz. an external or longitudinal, and an internal or circular; there are also some special fibres connected with the ends of the ureters. Muscular has two strata;

a. The *longitudinal* fibres surround the bladder, and extend from the apex to the base: above they are connected with the urachus, and below they are attached to the upper part of the prostate gland, with the exception of an anterior fasciculus on each side, which is united to the back of the os pubis, through the anterior true ligament of the bladder. On the front and back of the bladder the muscular layer is stronger, and its fibres more vertical, than on the lateral parts. Sometimes this layer of fibres has been called, from its action in expelling the urine from the bladder, *detrusor urinæ* muscle. external or longitudinal, form detrusor urinæ;

b. The *circular* fibres are thin, and scattered on the body of the bladder, but around the cervix they are collected into a thick bundle, which is called the *sphincter vesicæ*. In some instances the fibres are hypertrophied, and project into the interior of the organ, forming the fasciculated bladder; and in other cases the mucous coat may be forced outwards here and there between the fibres, producing little sacs, or the sacculated bladder. internal or circular give rise to sphincter.

c. The third set of muscular fibres is continued from the openings of the ureters to the prostate gland, and will be seen when the bladder is opened. Other muscular fibres.

Cellular coat.—This stratum is placed between the muscular and mucous layers, and is enumerated amongst the coats of the bladder; it is composed of areolar and elastic tissues as in other hollow viscera. Cellular coat.

Dissection. — The bladder is now to be opened by an incision down the front, and the same cut is to be continued along the upper part of the prostate gland. Open the bladder.

The *mucous membrane* of the bladder is continuous posteriorly with that lining the ureters, and anteriorly with that of the urethra. It is very slightly united to the muscular layer in consequence of the intervention of the submucous stratum, and is thrown into numerous folds in the flaccid state of the viscus, except over a small triangular surface behind the opening into the urethra. The membrane is soft and smooth to the feel, and of a pale rose colour in the healthy state. Its surface is studded with small mucous follicles, Mucous coat has folds except on one spot. Follicles.

Epithelium. particularly towards the neck of the bladder. A *spheroidal* or transitional epithelium covers the surface.

Interior of the bladder. *Interior of the bladder.*—Within the bladder the following parts are to be remarked, viz., the orifices of the ureters and urethra, the triangular space, and the muscles of the ureters.

Opening of urethra *Orifices.* — At the lower and anterior part of the bladder is the orifice of the urethra, surrounded by the prostate gland. The mucous membrane here presents some longitudinal folds, and the aperture is partly closed by a small with its uvula. prominence below, *uvula vesicæ*, occasioned by a thickening of the submucous tissue. This eminence is placed in front of the middle lobe of the prostate, and from its anterior part a slight ridge is continued to the floor of the urethra. About Openings of the ureters. an inch and a half behind the orifice of the urethra, and rather more than that distance apart, are the two narrow openings of the ureters. These excretory tubes for the urine perforate the wall of the bladder obliquely, lying in it for the distance of nearly an inch, and therefore the reflux of fluid through them towards the kidney is prevented, as the bladder is distended: they terminate on each side by a contracted slit-like opening in the centre of a prominence.

Trigone of the bladder; *Triangular surface.*—Immediately behind the orifice of the urethra is a smooth triangularly-shaped part of the bladder, which is named *trigone* (trigonum vesicæ). Its how bounded; apex reaches the prostate, and its base the ureters; or its boundaries may be marked out by a line on each side from the urethra to the ureter, and by a transverse one between part corresponding externally. the ureters. This space corresponds to the interval at the base of the bladder, between the prostate in front and the vesiculæ and vasa deferentia on the sides; and over it the mucous coat is closely united to the muscular, so as to prevent the accidental folds found in the other parts of the empty bladder.

To expose muscles of ureters. *Dissection.*—The muscles of the ureters will come into view on the removal of the mucous membrane in a line from the urethra to the opening of the ureter of each side: the fibres are best marked in a muscular bladder.

These muscles pass The *muscles of the ureters* are "two strong fleshy columns, which descend from the orifices of the ureters towards the

orifice of the bladder," where they become blended into one. "Where these columns unite, they are most fleshy, and their fibres are more intricate; then directing their course towards the lower and backmost part of the prostate, they degenerate into tendon, and are inserted into the portion called the third lobe of the prostate." * from ureters to the prostate.

Blood-vessels and nerves. — The source of the vesical *arteries* and the termination of the *veins* are before detailed (pp. 554. 558.). In the bladder they are disposed in greatest number about its base and neck. Most of the *nerves* that are distributed to the bladder, though supplied from the pelvic plexus of the sympathetic (p. 561.), are derived directly from the spinal nerves. Arteries; veins; nerves.

THE URETHRA AND PENIS.

Urethra. — The tube of the urethra extends from the neck of the bladder to the end of the penis, and has an average length of about eight inches. It is deficient in the strong fibrous coat that surrounds the mucous lining in other excretory ducts, but is supported by the structures that here and there surround it. The size of the canal varies at different spots, and the tube is divided, as before said (p. 544.), into a prostatic, a membranous, and a spongy part. Extent and length; no fibrous coat. Division into parts.

Dissection. — To open the urethra, let the incision through the upper part of the prostate be continued onwards to the extremity of the penis, so as to cut through the corpus cavernosum of that body rather on one side of the middle line, and to leave undivided its septum. How to open the urethra.

The *prostatic* part is nearer the upper than the lower aspect of the gland that surrounds it, and lies at first above the middle lobe of the prostate. It is about one inch and a quarter in length, and is altogether the widest and most extensible division of the urethral canal. The form of this part of the tube is spindle-shaped, for it is larger in the middle than at either end. Its transverse measurement, at the neck of the bladder, is about a quarter of an inch; at its Prostatic part. Dimensions and shape; diameter.

* From a Paper by Sir C. Bell, in the third vol. of the Med. Chir. Transactions: "Account of the Muscles of the Ureters."

centre a line or two more; and at the front rather less than at the beginning.

On the floor is a crest.

On the floor of the urethral passage, at the neck of the bladder, is the eminence of the uvula vesicæ. In front of this is a central longitudinal ridge of the mucous lining, which is prolonged anteriorly towards the membranous part of the canal, and is named *crest* of the urethra (verumontanum, caput galinaginis); it is formed, like the uvula, by a thickening of the submucous tissue.

In the crest is a pouch, which projects into the prostate,

and in which are the ejaculatory ducts.

In the central fold or crest of the mucous membrane, near its posterior extremity, is a slight hollow named *utricle*, or *sinus pocularis*. This depression is about a line wide at its orifice in the urethra; but from that spot it is directed backwards and downwards in the prostate, for the distance of a quarter of an inch or rather more, passing beneath the middle and between the lateral lobes, and ends by a cæcal and somewhat dilated extremity. In its wall, on each side, is contained the common ejaculatory duct, which opens by a narrow slit on or within the free margin of the mouth of the sac. Small glands likewise open on the surface of the mucous membrane lining it. Some bristles should be introduced into the ejaculatory ducts, to render evident their position and apertures. On each side of the central ridge or crest is an excavation of the glandular substance, named the *prostatic sinus*. Into this hollow the ducts of the lateral lobes of the prostate open, whilst the apertures of those of the middle lobe are seen at the posterior part of the central ridge, behind the hollow in it.

Prostatic sinuses also in floor.

Membranous part.

The *membranous part* of the urethra is nearly an inch in length, and intervenes between the apex of the prostate gland and the bulb of the corpus spongiosum urethræ. This is the narrowest portion of the whole canal, with the exception of the orifice, and measures rather less than a quarter of an inch. It is the weakest of the three divisions of the canal, and is supported only by a thin stratum of erectile tissue, by some vessels, and by the compressor urethræ muscle.

Dimensions.

Parts around.

Spongy part.

The *spongy part* includes the rest of the urethra, viz. to the end of the penis. It is about six inches in length, and

its strength depends upon an enveloping material, named corpus spongiosum urethræ. The average size of the canal is about a quarter of an inch in diameter, though at the vertical slit, by which it terminates on the glans penis, the tube is smaller than at any other part of the urethra. Two dilatations exist in the floor of the spongy portion:—one is contained in the bulb or bulbous part of the urethra, and is named *sinus* of the bulb; the other is situate in the glans penis, and has been called *fossa navicularis* from its shape.

Dimensions.

Two dilatations; one in bulb, one in glans.

Mucous lining of the urethra.—The mucous membrane of the urethra is continued into the bladder, as well as into the ducts opening into the canal, and joins in front the tegumentary covering of the glans penis. It is of a reddish colour as far back as the prostate, where it becomes whiter, and is thrown into longitudinal folds during the contracted state of the penis. Its surface is studded with follicles, and with the apertures of mucous glands; and its *epithelial* covering is of the columnar kind, but near the orifice this becomes laminar.

Extent; colour; folds, glands; epithelium.

Some small pouches or *lacunæ* are seen in the interior of the canal, chiefly along the floor, which have their apertures turned towards the outer orifice of the urethra. One of these is larger than the rest, *lacuna magna*, and is placed on the upper aspect or roof of the urethra, opposite the fossa navicularis. The ducts of the prostate and of Cowper's glands open on the mucous membrane: the former have been described above; the latter are two in number, and terminate, one on each side, on the floor of the urethra near the front of the bulb; but in the ordinary examination they are seldom recognised.

Lacunæ.

One larger than the rest.

Ducts of glands of Cowper.

Submucous tissue.—A stratum of common submucous tissue exists between the lining membrane of the urethra and the structures that surround that tube; but along the prostatic and membranous portions there is, in addition, a thin enveloping layer of erectile tissue, that is continued backwards from the corpus spongiosum urethræ to the neck of the bladder.

Submucous tissue and erectile tissue.

STRUCTURE OF THE PENIS.—The form and the connec-

Penis formed

of two vascular erectile bodies.

tions of the penis having been described at page 545., it remains now to notice the tissues of which it is composed. By means of the section already made through the penis, this body can be observed to be made up of two spongy and vascular substances — one filling the corpora cavernosa, the other constituting the corpus spongiosum urethræ.

Cavernous material; the structures of which it consists.

Corpora cavernosa. — Each corpus cavernosum is constructed of a firm fibrous tunic, which encloses a cavernous or trabecular structure, and contains a plexus of vessels in the intervals of the spongy mass in the interior. An incomplete median septum exists along the body of the penis between the corpora cavernosa.

A fibrous case

The fibrous case of the corpus cavernosum is a white, strong, elastic covering, from half a line to a line in thickness.

that sends in processes, viz.

Along the middle line of the penis a septal process is sent inwards from it; and numerous other finer offsets or trabeculæ project inwards to give origin to the spongy structure. It is formed of white shining fibres that are mostly disposed longitudinally.

One septal piece,

The septal process extends along the body of the penis, and is thicker and more perfect behind than in front. At the point of junction of the crura of the penis, this partition separates the enclosed cavity of the organ into two parts;

which is imperfect,

but as it reaches forwards it becomes less strong, and is pierced by elongated apertures, which give it the appearance of a comb, whence the name *septum pectiniforme.* Through the intervals in the septum the vascular tissue of one corpus cavernosum communicates with that of the other.

and numerous bands and cords to form a network.

The cavernous or trabecular structure is formed by fibrous bands and cords that cross in all directions the enclosed cavity of the corpus cavernosum, giving rise to a network in the interior. The fibrous processes are thinner towards the centre than at the circumference of the fibrous case; and the areolar spaces are larger in the centre and at the fore part of the contained cavity, than at the circumference or in the crura penis.

In the cords some pale fibres.

In addition to white fibrous tissue, the trabeculæ contain some elastic fibres, together with a reddish structure supposed to be pale muscular fibres (Müller). The

cellular structure of the penis may be demonstrated by means of sections of that body distended with air and dried, or injected with tallow that has been afterwards removed.

Blood-vessels.—The blood-vessels of the penis are large in size, and serve to nourish as well as minister to the function of the organ. Having entered the cavernous mass, they ramify in the interstices of the trabecular structure, and produce the erectile tissue.

Vessels are erectile;

The *veins* commence by dilatations or venous cells, that fill the interspaces of the areolar structure, and anastomose freely together to form venous plexuses. In these spaces the walls of the veins are very thin, because they receive support from the surrounding fibrous structure. Into the large radicles of the veins the arterial capillaries pour their contents, and thus produce the erectile condition of the corpus cavernosum by the dilatation of those receptacles. By means of the apertures in the septum the veins of opposite sides communicate freely.

veins are dilated and form plexuses.

Most of the veins of the corpus cavernosum issue along the upper and under aspects of the penis, to end in the dorsal vein; but some escape near the roots of that body, and join the pudic vein and the prostatic plexus.

Ending of the veins.

The *arteries* of the corpora cavernosa are offsets of the pudic, both at the root and along the body of the penis. Entering the cavernous structure, they divide into branches, which ramify in the trabeculæ until they cease in one of the two following ways:—The greater number of the vessels terminate in capillaries, as in other parts, which open into the dilated veins in the intertrabecular spaces; but others of the terminal twigs end in tufts of short, slightly curled vessels—the *helicine* arteries of Müller, which project into the intertrabecular spaces, and become imbedded in the thin veins. These twisted vascular bodies have dilated cæcal extremities, and do not communicate with the veins. The helicine arteries exist in greatest number at the posterior part of each corpus cavernosum.

Source of the arteries.

Termination either in dilated veins, or as the helicine arteries.

Corpus spongiosum urethræ.—This constituent part of the penis surrounds the urethra, and forms alone the bulb and the glans penis (p. 546.). The urethra is not enveloped equally on all sides by this tissue, for, at the bulb, only a thin stratum is above the canal. Posteriorly an offset of the corpus spongiosum is continued beyond the bulb, around the urethra.

Spongy material of the penis;

Its structure like cavernous. *Structure.* — The tissue of the corpus spongiosum is similar to that of the corpus cavernosum: thus it consists of a fibrous tunic, that encloses a trabecular structure, and a plexiform arrangement of the blood-vessels.

The fibrous case. The fibrous covering is less dense and strong than in the corpus cavernosum, but it sends inwards processes to form a network. Imperfect septum. Moreover a piece projects inwards in the middle line, opposite the bulb, which reaches forwards a short distance, and assists in dividing that body into two lobes. The trabecular bands are much finer, and more uniform in size, than those of the corpus cavernosum.

Blood-vessels likewise erectile, *Blood-vessels.* — The terminal arrangement of the blood-vessels to produce the erectile structure of the corpus spongiosum is the same as in the corpora cavernosa; but the and helicine. helicine terminations of the arteries are absent from the glans penis, where the veins form a very close and regular plexus.

Source of arteries. The chief *artery* on each side (artery of the bulb) is derived from the pudic, and enters the spongy structure at the bulb. Kobelt describes another branch to the same part, at its upper aspect.

Termination of the veins. Most of the *veins*, including those of the glans, end in the large dorsal vein of the penis, some communicating with the veins of the cavernous body; but others issue from the bulb, and terminate in the pudic vein, and in the prostatic plexus.

Nerves. *Nerves and lymphatics.*—The *nerves* of the penis are large, and are furnished both by the spinal and sympathetic nerves (pp. 560 Lymphatics. —562). The superficial *lymphatics* join the inguinal glands; the deep ones accompany the veins beneath the arch of the pubes, to end in the glands in the pelvis.

THE RECTUM.

Rectum is smooth. The lower end of the large intestine, that is contained in the pelvis, is not sacculated like the colon, but is smooth on the surface.

To prepare the gut. *Dissection.*—The rectum is to be washed out, and then distended with air. Afterwards, the peritoneum and the loose cellular membrane are to be removed from it.

The rectum is about eight inches in length, and its average diameter is that of the sigmoid flexure of the colon. Its size is uniform till towards the lower extremity, where it is dilated, particularly in old people, but at the aperture of termination in the anus the gut is smaller than in any other part of its extent. The longitudinal bands of the colon are absent from this portion of the alimentary canal, and the fibres are spread over the surface. Length; dimensions.

Structure. — The rectum, like the rest of the large intestine, contains in its wall a peritoneal, a muscular, a mucous, and a submucous stratum; and further, the muscular and the mucous layers have certain peculiarities that serve to distinguish the rectum from other parts of the intestinal tube. Same coats as in the rest of the intestine.

The *peritoneum* forms but an incomplete covering, and its extent is referred to in the description of the connections of the pelvic viscera (p. 540.). Peritoneum.

The *muscular* coat consists of two planes of fibres, as in the œsophagus, viz. a superficial or longitudinal, and a deep or circular. Muscular coat

The *longitudinal* fibres are continuous with those in the bands on the colon, but are here diffused to form a stratum around the gut. has longitudinal

The *circular* fibres describe arches on the intestine, and become thicker and stronger towards its lower extremity, where they are collected into the band of the internal sphincter muscle. These fibres belong to the pale or unstriped kind, but in the sphincter some striped or voluntary fibres are present. and circular fibres.

The *mucous* coat is here more movable than in the colon, and resembles in that respect the lining of the œsophagus; it is also thicker and more vascular than that of the rest of the large intestine. When the bowel is contracted the mucous lining is thrown into numerous accidental folds, some of which near the anus are longitudinal. But there are other permanent folds (three or four), described by Mr. Houston, which are about half an inch in width, and contain Mucous coat thick and vascular. Folds in it: some are permanent.

some of the circular fibres of the gut.* The most constant of these is about three inches from the anus, on the front of the rectum, opposite the base of the bladder; another is found on the right side of the intestine near the top; and the third is on the left side, midway between the other two: occasionally there is a fourth on the back of the rectum, about an inch from the anus. These folds are not seen unless the gut has been hardened in spirit, whilst in its natural condition in the pelvis.

Structure; The mucous membrane has the same general structure as in the colon, but towards the anus the secretory apparatus gradually disappears.

Arteries. *Blood-vessels.*—The *arteries* are supplied from three different sources: they are, superior hæmorrhoidal, from the inferior mesenteric; middle hæmorrhoidal, from the internal iliac artery; and inferior hæmorrhoidal, from the internal pudic. The *veins* are deficient in valves, and communicate freely around the lower end of the gut. Above, they join the inferior mesenteric vein, and, through it, reach the vena portæ; and, posteriorly, they pour some blood into the internal iliac vein by branches corresponding to the middle hæmorrhoidal artery.

Veins are without valves.

Nerves; lymphatics. *Nerves and lymphatics.*—The nerves are obtained from both the sympathetic and the spinal system. The lymphatics terminate in the chain of glands on the sacrum.

Section VI.

ANATOMY OF THE VISCERA OF THE FEMALE.

Viscera in the pelvis. The viscera of the female pelvis consist of those common to the male and female, viz. the bladder and urethra, with the rectum; and of those that are special to the female, viz. the organs of generation.

To remove the viscera *Dissection.*—The contents of the pelvis are to be removed together with the genital organs. In this proceeding, the student

* Vol. v. of the Dublin Hospital Reports, "Observations on the Mucous Membrane of the Rectum."

is to keep the scalpel close to the osseous boundary of the pelvic outlet, to avoid the end of the rectum, and the crura of the clitoris that are connected to the bone. After the parts referred to are taken from the body, the rectum is to be detached from the uterus and vagina, but the rest of the viscera may remain united until the genital organs have been examined. The bladder may be moderately distended, and all the parts are to be freed from cellular membrane and vessels. and prepare them.

ORGANS OF GENERATION.

The generative organs of the female are classed, from their position with respect to the pelvis, into external and internal.

The external organs are included in the term vulva, or pudendum; they consist of the mons Veneris and external labia, of the clitoris and internal labia, of the vestibule with the meatus urinarius, and of the aperture of the vagina, with the hymen or the remnants of it. External organs are

Mons Veneris and labia pudendi.—In front of the os pubis the integument is covered with hair, and is raised into a slight eminence, *mons Veneris*, by a layer of subjacent fat. Extending downwards from the prominence mentioned are two folds of integument, the *labia pudendi* (labia majora), which correspond to the scrotum in the male. Above and below, the labia are united, the points of junction being named commissures, but between them is an interval called *rima*. The labia decrease in thickness inferiorly; they are covered externally with a few hairs, but are lined internally with a mucous membrane provided with follicles and sebaceous glands. In them is a tissue resembling the dartos of the male scrotum. Within the lower commissure of the labia is a small thin transverse fold of integuments named *fourchette*, or frænulum; and between this fold and the lower commissure is the interval of the *fossa navicularis*. mons Veneris and labia majora. Fourchette and fossa.

Clitoris and nymphæ.—Beneath the upper commissure of the labia majora the small projection of the clitoris will be found, with the nymphæ descending from it. Clitoris

dissection to see it. *Dissection.*—To see the clitoris, remove the integument forming the upper commissure, and, having exposed the body of the organ, follow outwards the crura, one to each side.

It is like the penis; The clitoris is a small erectile organ, and is the analogue of the penis in the male, which it resembles in structure, except that the urethra and its spongy enveloping substance are not applied below it. has a glans and prepuce, Its anterior extremity is terminated by a rounded part or *glans*, and is covered by a fold of the skin, corresponding to the prepuce of the male, which is provided with sebaceous glands. In structure this organ resembles the penis in the following particulars: — it consists of corpora cavernosa, corpora cavernosa, which are attached by crura (one on each side) to the rami of the ischium and pubis, and are then blended to form one body, with an imperfect pectiniform septum; and further, the glans is composed of the tissue of the corpus spongiosum. and erectile tissue. In the interior is an erectile tissue, like that of the male (p. 573.). Labia minora descend from prepuce. The *nymphæ* (labia minora) are two folds of mucous membrane that descend from the end of the clitoris, one on each side of the orifice of the vagina: they are continuous above with the preputial covering of the clitoris, and extend down about one inch and a half. The inner surface is continuous with the lining of the vagina, and the outer with the covering of the external labium. A plexus of blood-vessels is contained in each fold.

Vestibule. *Vestibule and orifice of the urethra.*—Within the nymphæ, between the clitoris above and the vagina below, is an angular interval, about one inch and a half deep, which is called the *vestibule*. Opening of the urethra. In the middle line of the vestibular space is the round orifice of the urethra, which is contained in an eminence about one inch below the clitoris, and near the aperture of the vagina.

Aperture of the vagina. *Orifice of the vagina and the hymen.* — The aperture of the vagina is close below the meatus urinarius, and varies much in size. In the child and in the virgin it is partly closed below by a thin semilunar fold of mucous membrane named the *hymen*. Hymen and carunculæ. After destruction of the fold, small irregularly-shaped projections, *carunculæ myrtiformes*, remain around the opening of the vagina.

The internal generative organs are the uterus and vagina, with the ovaries, and the Fallopian tubes.

Dissection. — The bladder is to be separated from the uterus, and the urethra to be detached from the substance of the vagina. The surface of the vagina, and of the lower part of the uterus, should be cleaned, but the peritoneal investment of the latter is to be left untouched for the present. Separate vagina and uterus.

THE VAGINA.

The vagina is a dilatable tube, that is connected with the uterus at one end, and terminates in the vulva at the other. It has a curved course between the two points mentioned, and the anterior and posterior parts do not equal one another in length, for whilst the former measures about four inches, the latter is about five or six in extent. Extent and curved course.

In its position in the body the tube is flattened from above downwards, so that the opposite surfaces may be in contact, but the upper end is rounded where it is joined to the uterus. Its size varies at different spots: thus the external orifice which is surrounded by the constrictor vaginæ muscle is the narrowest part, the middle portion is the largest, and the upper end is intermediate in dimensions between the other two. Form and size.

After the vagina has been laid open by an incision along the upper wall, the position of the uterus in that wall, instead of the extremity, can be remarked; and further, the tube will be seen to extend higher on the posterior than the anterior aspect of the cervix uteri. On the inner surface of the vagina, towards the lower part, is a slight longitudinal ridge both in front and behind, named *columns* of the vagina. Other transverse ridges or *rugæ* may be seen passing between the columns, before the tissue of the vagina has been distended. Interior has columns and rugæ.

The wall of the vagina is thicker anteriorly where the urethra is situate than at any other part of the canal. Wall.

Structure. — The vaginal wall is formed by a spongy erectile tissue, which is covered externally by a dilatable and An erectile structure

in the wall. vascular fibro-cellular layer, and lined internally by mucous membrane. At its lower end the tube is surrounded by a band of the fibres of the sphincter vaginæ muscle (p. 411.).

Erectile tissue The *erectile* tissue is most abundant at the lower part of the vagina, where it gives the greater thickness to the wall. Two masses of the erectile tissue, one on each side of the *forms semi-bulbs,* vagina, have been described as the *semi-bulbs* by Taylor, and as the *bulbi vestibuli* by Kobelt. They are elongated masses of plexiform veins, about an inch in length, which are enclosed in fibrous membrane, and are situate one on each side of the vestibule, where they are covered on the outer side by the constrictor vaginæ. At its upper part each is pointed, is continued to the clitoris, and communicates with the vessels of that body; whilst at the posterior rounded part it joins *which correspond to the bulb of the male.* the venous plexus of the vagina. These bodies are supposed by Kobelt to be analogous to the bulb of the corpus spongiosum urethræ in the male; each lateral part into which it has been divided being thrust aside in the female towards the crus clitoridis by the aperture of the vagina, instead of forming one piece in the middle line.

Mucous membrane of the vagina. The *mucous membrane* is continued through the lower aperture, over the vessels of the nymphæ, which it encloses, to join the integument on the labia majora; and through the os uteri, at the opposite end, to the interior of the uterus. Many muciparous glands and follicles abound on the surface, but these are in greatest abundance at the upper part. A laminar *epithelium* gives a lining to the membrane.

Arteries. *Blood-vessels and nerves.* — The *arteries* are derived from the *Veins are plexiform.* visceral branches of the internal iliac. The *veins* corresponding to the arteries form a plexus around the vagina, as well as in the external generative organs, and open into the internal iliac vein. For a description of the nerves see page 562.

Two glands analogous to Cowper's. *Glands of Bartholine.* — On the outer part of the vagina, near the aperture at the lower end, may be found a small yellowish glandular body on each side, that is analogous to Cowper's gland in the male. Each is about the size of a small bean, and is provided with a duct that is directed forwards to open on the inner aspect of the corresponding nympha.

THE UTERUS.

Definition;

The uterus or womb is an organ formed chiefly of involuntary muscular fibres, which receives and retains for a fixed period the developing ovum.

form; how changed.

This viscus, in the virgin state, is pear-shaped, or rather triangular in consequence of the body being flattened, and presents inferiorly a rounded narrow part or neck. Deviations from the standard shape will be found in the infant, in which the neck is larger than the body, and in the aged female, in whom there is little separation between the same two parts.

Dimensions.

Commonly the uterus measures about three inches in length, two in breadth at the upper part, and an inch in greatest thickness. Its weight varies from an ounce to an ounce and a half, but after gestation its size and volume always exceed the specification here made of them.

Upper end. The lower end is small; has an opening. Body; sides.

The *upper* end or *fundus* is convex, and comprises the part of the organ above the attachment of the Fallopian tube: it is covered by peritoneum. The *lower*, small and rounded end, which is named the neck of the uterus (*cervix uteri*), is surrounded by the vagina, and is covered by it to a greater extent behind than in front. It is about half an inch in length, and gradually tapers towards the extremity. In the lower end is a transverse aperture of communication between the uterus and the vagina, named *os uteri* (*os tincæ*), whose margins or lips (labia) are smooth, and anterior and posterior in situation: of these the hinder one is the longest. The *body*, or the intervening part of the uterus, is more convex posteriorly than anteriorly, and decreases in size down to the neck. It is covered on both aspects by the peritoneum, except about half an inch in front, at the lower part, where it is connected to the bladder. To each side, which is straight, are attached the parts contained in the broad fold of peritoneum, viz. the Fallopian tube at the top, the round ligament rather below and before it, and the ovary and its ligament below and behind the others.

Open the uterus.

Dissection.—To examine the interior of the uterus, make a cut along the anterior wall, from the fundus to the os uteri, and then take away enough of the tissue on each side of the middle line to expose the contained cavity.

Its thickness.

The thickness of the uterine wall is greatest opposite the middle of the body and at the centre of the fundus; but from those spots the wall becomes thinner towards the attachment of the Fallopian tubes.

In the interior is a triangular space in the body, which is narrowed below, and a spindle-shaped space in the neck.

Interior of the uterus.—Within the uterus is a small space, which is divided into two parts—one of the body, another of the neck of that organ. The *space* occupying the *body* of the viscus is triangular in form, and is larger than the other. Its base is at the fundus of the uterus, where it is convex towards the cavity, and the angles thereof are prolonged towards the Fallopian tube, that opens into the cavity on each side. The apex is directed downwards, and joins the cavity in the cervix by a narrowed circular part, *isthmus* (os uteri internum); and this communicating aperture may be smaller than the opening from the cervix into the vagina. The *space* within the *neck* terminates inferiorly at the os uteri; it is larger at the middle than at either end, being spindle-shaped, and is somewhat flattened, like the cavity of the body. Along both the anterior and the posterior wall is a longitudinal ridge, and from these other ridges (*rugæ*) are directed obliquely on each side: this appearance has been named *arbor vitæ uterinus*. In the intervals between the rugæ are some mucous follicles, which sometimes become enlarged with fluid, giving rise to the *ovula* of *Naboth*.

In the neck are ridges or the arbor vitæ.

Uterus is a muscular organ.

STRUCTURE.—The dense wall of the uterus is composed of layers of unstriped muscular fibre, intermixed with fibro-cellular structure, and large blood-vessels. On the exterior is the peritoneum, and lining the interior is a thin mucous membrane.

There are three strata: external,

The *muscular* fibres can be demonstrated at the full period of gestation to form three strata in the wall of the uterus, viz. external, internal, and middle. The *external* layer contains fibres which are mostly transverse, and are more

marked at the fundus and at the sides than along the middle of the organ. Externally the fibres converge towards the broad ligament, into which some are inserted, whilst others are prolonged on the Fallopian tube, the round ligament, and the ligament of the ovary. The *internal* set describe circles around the openings of the Fallopian tubes, and spread therefrom till they meet at the middle line of the uterus. The *middle* or intervening set of fibres are more indistinct than the others, and have a less determinate direction.

internal, and middle.

The *mucous* lining is continued into the vagina at one end of the uterus, and into the Fallopian tubes at the other. In the interior of the uterus it is thin, smooth, and adherent, and, like the mucous membrane of the intestine, its surface is covered with the apertures of tubular *glands*, which may be either straight and simple, or may be twisted or branched. Between the rugæ of the cervix uteri mucous *follicles* are collected. The *epithelial* covering of the mucous membrane is columnar and ciliated as far as the middle of the cavity of the neck, but laminar beyond that point.

Mucous lining is covered with glands. Follicles in the neck. Epithelium.

The *blood-vessels* of the uterus are large and tortuous, and occupy canals in the uterine substance, in which they communicate freely together. The *arteries* are furnished from the uterine and ovarian branches; and the *veins* correspond with the arteries in name and number. The *nerves* are derived from the sympathetic, and are very small in proportion to the size of the uterus. They are not enlarged in pregnancy, according to Mr. Beck.*

Vessels are large. Arteries; veins; nerves.

Round ligament of the uterus.—This firm cord supports the uterus, and is contained partly in the broad ligament and partly in the inguinal canal (p. 432.). It is about four or five inches in length, and is attached to the upper part of the uterus close below, and anterior to the Fallopian tube. A tube of the peritoneum accompanies the part of the cord in the inguinal canal, and sometimes remains pervious for a short distance. The ligament is composed of unstriped muscular fibres, derived from the uterus, together with vessels and cellular membrane.

This cord ends in groin. Attachment to uterus; how formed.

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* See a Paper in the Philosophical Transactions for 1846.

OVARIES AND FALLOPIAN TUBES.

Position; OVARY.—The ovaries are two bodies, analogous to the testes of the male, which are contained in the broad ligaments of the uterus, one in each, and at the posterior aspect.

orm and colour; Each ovary is of an elongated form, somewhat flattened from above down, and of a whitish colour; with either a dimensions smooth or a scarred surface. Its volume is variable, but in the virgin state it is about one inch and a half in length, half and weight. that size in width, and a third in thickness; its weight is nearly a quarter of an ounce.

Connections. The ovary is connected with the broad ligament by its anterior margin, where the vessels enter it. Its outer end is rounded, and is connected with one of the fimbriæ at the mouth of the Fallopian tube; but the inner extremity is narrowed, and is attached to the side of the uterus by a fibrous cord (ligament of the ovary) below the level of both the Fallopian tube and round ligament.

Glandular in structure. *Structure.*—The ovary consists of a spongy vascular tissue or stroma, which contains small vesicles, named Graafian, and is enclosed within a fibrous tunic. The peritoneum surrounds the whole, except at the attached margin.

A fibrous coat surrounds stroma. The special *fibrous* coat (tunica albuginea) is of some thickness and of a whitish colour, whence its name, and is adherent to the contained stroma. Sometimes a yellow spot (corpus luteum) or some fibrous cicatrices may be seen in this covering.

In the stroma are small vesicles. The *Graafian vesicles* are small round transparent bodies, from eight to twenty in number, which vary in size from a pin's head to a pea, and are scattered through the stroma of Size and number; the ovary. They are largest in size towards the circumference of the organ, and sometimes may be seen projecting coats; through the fibrous coat. Each consists of two transparent coats, external and internal: the outer is a vascular covering; and the inner membrane, named *ovi capsule*, is lined by a granular epithelial layer (membr. granulosa of Baer). In contents. the interior is a transparent albuminous fluid in which is

suspended the minute vesicular ovum, together with molecular granules.

When the Graafian vesicle is matured it bursts on the surface of the ovary, and the contained ovum escapes into the Fallopian tube. After the shedding of the ovum the ruptured vesicle gives origin to a yellow substance, *corpus luteum*, which changes finally into a cicatrix. Shedding of a vesicle. Formation of corpus luteum.

Blood-vessels and nerves. — The ovarian *artery* pierces the ovary at the anterior or attached border, and its branches run in zig-zag lines through the stroma. The *veins* of this body, after escaping from its substance, form a plexus (*pampiniform*) near the ovary, and within the folds of the broad ligament. The *nerves* are derived from the sympathetic on the ovarian and uterine vessels. Artery; veins; nerves.

Fallopian Tubes. — The tubes thus named convey the ova from the ovaries to the uterus, and perform for those secretory organs the same office as the vasa deferentia discharge for the testes in the male. Use,

The tubes are two in number, one on each side, and are about four inches in length. Each is cord-like at the inner end, where it is attached to the upper part of the uterus, but increases in size towards the outward part, and terminates in a wide extremity, like the mouth of a trumpet. This dilated end is fringed and named *corpus fimbriatum*, and the serrations of its circumference are called fimbriæ. If the fimbriated end is floated out in water, one of the processes may be seen to be connected with the outer end of the ovary; whilst in the centre of them is a groove that leads to the orifice of the Fallopian tube. length, and form. It is dilated externally, and fimbriated.

On opening the tube with care the size of the contained space, and the small aperture into the uterus, can be observed. Its canal varies in size at different spots; the narrowest part is at the orifice into the uterus, where it scarcely gives passage to a fine bristle; towards the outer end it increases a little, but it is again rather diminished in diameter at the outer aperture. Size of the tube is least at the ends

Structure. — This excretory tube has the same component parts as the uterus with which it is connected, viz. a muscular A muscular structure.

tunic, covered externally by peritoneum, and lined by mucous membrane.

Fibres prolonged from uterus. The *muscular* coat is formed of an external or longitudinal, and of an internal or circular layer, and both are continuous with similar strata in the wall of the uterus.

Mucous coat is continuous with peritoneum. The *mucous membrane* forms some longitudinal folds, particularly at the outer end. At the inner extremity of the canal it joins the mucous lining of the uterus, but at the outer end it is continuous with the peritoneal covering. A columnar ciliated *epithelium* covers the surface, as in the uterus.

Vessels. The *blood-vessels* and *nerves* are furnished from those that supply the uterus and ovary.

THE BLADDER, URETHRA, AND RECTUM.

Anatomy of the bladder, given before. Bladder. — The peculiarities in the form and size of the female bladder have been noticed in the description of the connections of the viscera of the female pelvis (p. 550.). For a notice of its structure the anatomy of the male bladder is to be referred to (p. 566.).

Preparation of it. *Dissection.* — To prepare the bladder, distend it with air, and remove the peritoneal covering and the cellular membrane from the muscular fibres.

Length of urethra; Urethra. — The length and the connections of this excretory tube are stated in page 551.

size; When the canal is opened along the upper part, its diameter will be found to be rather more than a quarter of an inch, though it is enlarged and funnel-shaped towards the neck of the bladder. Near the external aperture there is a hollow in the floor of the tube. In consequence of not being surrounded by any resistant structure the urethra is much more dilatable than the corresponding passage in the male. it can be much dilated.

Tube like that in the male. *Structure.* — This tube, like the urethra of the male, consists of a mucous coat, which is enveloped by a plexus of blood-vessels, also in one spot by muscular fibre, and is supported by the parts through which it passes.

The *mucous* coat is generally pale till near the outer orifice. It is marked by longitudinal folds, one of which in the floor of the canal resembles the median crest in the male urethra (p. 570.). Around the outer orifice are some mucous *follicles;* towards the inner end are some tubular mucous *glands*, whose apertures are arranged in lines between the folds of the membrane, and are turned towards the bladder. A laminar *epithelium* is spread over the surface, which becomes irregular in form (spheroidal) at the bladder. Mucous coat. A fold in floor. Follicles and glands. Epithelium.

A *submucous* stratum of areolar and elastic tissues intervenes between the mucous coat and the vascular and erectile structure that envelops the canal of the urethra. Submucous tissue.

RECTUM.—The structure of the rectum is so similar in the two sexes, that the student may use the description given with the anatomy of the viscera of the male pelvis (p. 574.). Rectum like that of the male.

Dissection. — The rectum may be prepared for examination by distending it, and removing the peritoneal covering and the cellular membrane from it. Preparation of rectum.

SECTION VII.

INTERNAL MUSCLES AND THE LIGAMENTS OF THE PELVIS.

MUSCLES. — The two following muscles, pyriformis and obturator internus, are lodged in the cavity of the pelvis at their origin. Two muscles.

The PYRIFORMIS MUSCLE arises within the pelvis by a wide fleshy part, and is directed outwards through the great sacro-sciatic notch to be inserted into the great trochanter of the femur. Narrowing in its progress, the muscle has received its name from its form. Pyriformis. Situation.

In the pelvis the pyriformis is attached by three slips to the second, third, and fourth pieces of the sacrum, both between the anterior apertures and external to them; as it passes from the pelvis it takes origin also from the surface of the ilium which forms the upper part of the great sacro- Origin in the pelvis.

sciatic notch, and from the great sacro-sciatic ligament. From this origin the fibres converge to the tendon of *insertion* into the trochanter. (See DISSECTION OF THE BUTTOCK.) The anterior surface is in contact with the rectum, with the sacral plexus, and with the sciatic and pudic branches of the internal iliac vessels; whilst the opposite surface rests on the sacrum, and is covered by the great gluteal muscle outside the pelvis. The upper border is near the ilium, but separated from it by the gluteal vessels and the superior gluteal nerve; and the lower is contiguous to the coccygeus muscle, only the sciatic and pudic vessels and nerves intervening.

Insertion.

Its connections with parts around.

Obturator muscle

The OBTURATOR INTERNUS MUSCLE, like the preceding, has its origin in the pelvis, and its insertion outside the cavity into the great trochanter of the femur; but the part outside the pelvis is almost parallel in direction with the portion inside.

is bent over pelvis.

Origin in the pelvis.

The muscle *arises* by a broad fleshy attachment from the inner surface of the obturator membrane, and from the fibrous arch bounding the notch containing the obturator vessels and nerve; from the surface of bone internal to the membrane; and from the os ischii between the foramen and the ischiatic notch, as high as the brim of the pelvis. The fibres are directed backwards and somewhat downwards, and end in four or five tendinous pieces, which turn over the sharp pulley-like surface of the ischium, corresponding to the space of the small sacro-sciatic notch. Outside the pelvis these tendons are blended into one, which is fixed into the great trochanter: its connections are described with the dissection of the buttock. By one side the muscle is in contact with the wall of the pelvis and with the obturator membrane; by the other side with the fascia lining the pelvic wall, and containing the pudic vessels and nerve towards the lower border of the obturator. Above the level of the levator ani, viz. from the lower part of the symphysis pubis to the spine of the ischium, the muscle corresponds to the cavity of the pelvis, but below that line, to the ischio-rectal fossa.

Arching of its tendons over the ischium.

Insertion.

Part of muscle is in pelvic cavity,

part in perinæal space.

ARTICULATIONS OF THE PELVIS.

The several bones of the pelvis have the following articulations with one another. The sacrum is joined by its base to the last lumbar vertebra, and by its apex to the coccyx, by special ligaments. Laterally, this central bone is united with the two innominate bones. And the innominate bones are further connected together in front, as well as to the sacrum and the spinal column posteriorly. Outline of the articulations.

Sacro-vertebral Articulation. — The base of the sacrum is articulated with the last lumbar vertebra by the same ligaments as unite one vertebra to another (p. 354.) and by one special ligament—the sacro-vertebral. Union of sacrum with last vertebra.

Dissection. — For the best manner of bringing these different ligaments into view, the dissector must consult what is written respecting the ligaments of the vertebræ. Dissection.

The *common ligaments* between the bodies of the two bones are an anterior and a posterior ligament, with an intervening fibro-cartilaginous substance. Between the processes are the ligamenta subflava, interspinous bands, and capsular ligaments and synovial membranes for the articular processes. By ligaments as in the vertebræ,

The *sacro-vertebral* ligament is a strong bundle of fibres, that reaches from the under aspect of the tip of the transverse process of the last lumbar vertebra, to the lateral part of the base of the sacrum. Widening as it descends, the ligament spreads and joins the fibres in front of the lateral articulation between the sacrum and the innominate bone. and by a special band, sacro-vertebral.

Sacro-coccygeal Articulation. — The sacrum and coccyx are united by a fibro-cartilage, and by an anterior and a posterior common ligament. Union of sacrum and coccyx.

Dissection. — For these ligaments little dissection is necessary. When the cellular membrane has been removed altogether from the bones, the ligaments will be apparent. Dissection.

The *anterior ligament* (sacro-coccygeal) consists of a few An anterior and

fibres that pass between the bones in front of the fibro-cartilage.

a posterior ligament, The *posterior ligament* is wide at its attachment to the lower margin of the orifice of the sacral canal, but narrows as it descends to be inserted into the coccyx.

and a fibro cartilage. The *fibro-cartilage* resembles that between the vertebræ, and is attached to the surface of the bones.

Union of the pieces of the coccyx. When the several pieces of the coccyx are not united by bone they are connected together by *anterior* and *posterior* bands, and by intervening thin *fibro-cartilage*. But in the male adult the bones are generally joined by ossific matter.

Union between the sacrum and ilium. SACRO-ILIAC ARTICULATION. — The irregular surfaces by which the sacrum and innominate bones touch, are covered with cartilage, and maintained in contact by anterior and posterior ligaments. Inferiorly the bones are further connected, without being in contact, by the strong sacro-sciatic ligaments.

To dissect the ligaments. *Dissection.* — It will be necessary to remove the mass of muscle at the back of the sacrum, on the side on which the innominate bone remains, to see the posterior ligaments; but the anterior will be visible on the removal of some cellular membrane. The great sacro-sciatic ligament is dissected with the lower limb, and the small ligament will be brought into view by removing the coccygeus.

Anterior The *anterior sacro-iliac* ligament consists of a few thin scattered fibres, that are attached to the sacrum and ilium near their articular surfaces.

and posterior ligaments; The *posterior ligaments* (sacro-iliac) are much stronger than the anterior, and the fibres are collected into bundles. These ligaments pass from the rough inner surface of the posterior extremity of the innominate bone to the first two pieces of the sacrum. One bundle, which is distinct from the others, and more superficial, is named the *oblique* or *long posterior* ligament; it is attached to the posterior superior spinous process of the ilium and descends almost vertically to the third piece of the sacrum.

one more distinct than the rest,

with articular cartilage. *Articular cartilage.* — Between the irregular surfaces of the bones in this articulation (sacro-iliac symphysis) is a thin

uneven layer of cartilage. This will be seen by forcibly separating the bones, after the other ligaments are examined.

Two *sacro-sciatic ligaments* pass from the lateral part of the sacrum and coccyx to the spine and tuberosity of the ischium, across the space at the back of the pelvis, between the innominate bone and the sacrum; by their position they convert the large sacro-sciatic excavation into two apertures or foramina (sacro-sciatic), which are described in the dissection of the buttock. These ligaments are named large and small. Sacro-sciatic ligaments are two;

The *large* ligament reaches from the side of the sacrum and coccyx to the tuberosity of the ischium; but it may have been cut in the dissection of the gluteal region, with which it is examined. large,

The *small* ligament is attached internally by a wide part to the border of the sacrum and coccyx, where it is united with the origin of the preceding ligament. The fibres are directed outwards to the spine of the ischium, and are inserted into it by a narrowed part. Its pelvic surface is covered by the coccygeus muscle, and its opposite aspect by the great sacro-sciatic ligament. Above this ligament, between it and the bone, is the large sacro-sciatic foramen, and below it is the small foramen of the same name. small. Attachments and connections.

LIGAMENTS OF THE INNOMINATE BONES. — The innominate bones are united in front at the pubic symphysis, by an interposed fibro-cartilage and special ligaments; and behind they are connected with the transverse process of the last lumbar vertebra by a ligament on each side. In the centre of the bone is a membranous structure closing the obturator aperture. Special ligaments of the lateral bones of the pelvis.

The *ilio-lumbar ligament* is triangular in form and is divided into fasciculi. Internally it is attached by its apex to the tip of the transverse process of the last lumbar vertebra, and externally the fibres spread out, and are inserted into the crest of the ilium opposite the posterior part of the iliac fossa. To the upper border of this ligament is attached part of the fascia lumborum; its posterior surface is covered by the erector spinæ, and its anterior by the iliacus muscle. Ilio lumbar fixes the bone behind.

Obturator membrane closes an aperture in front.

The *obturator membrane* closes the foramen of the same name, and is composed of fibres crossing in different directions. It is attached to the bony margin of the foramen, except above where the obturator vessels lie, and is connected towards the inner part to the pelvic aspect of the bone. The surfaces of the ligament give attachment to the obturator muscles, and branches of the obturator artery and nerve perforate it.

Union of the ossa pubis.

Pubic Articulation (symphysis pubis).—The oval surfaces of the ossa pubis are united by fibro-cartilage, and by scattered fibres in front, behind, and above the bones. They are also connected by a strong sub-pubic ligament.

Anterior band.

The *anterior pubic ligament* is formed of different layers of fibres: the superficial ones are oblique between the bones, and cross one another, uniting with the aponeurosis of the external oblique muscle of the abdomen; but the deeper fibres are transverse, and are connected with the fibro-cartilage.

Posterior band.

The *posterior* and *superior* ligamentous bands of fibres are placed as their names express, but are indistinct.

Sub-pubic ligament.

The *sub-pubic ligament* (ligam. arcuatum) is a strong triangularly-shaped band below the symphysis, and occupies the upper part of the pubic arch. Its fibres curve downwards, and are attached on each side to the upper part of the rami of the pubes. The apex of the ligament touches the fibro-cartilage, and the base is turned to the membranous part of the urethra and the muscle around it.

Fibro-cartilage.

Fibro-cartilage. — When the articulation of the symphysis is forcibly separated, each pubic bone will be covered by a white elastic piece of fibro-cartilage. These pieces consist of concentric layers; and when the two are in contact, they give rise to a mass, which is thicker anteriorly than posteriorly, and widest above and below. One half is connected with the other by transverse fibres near the anterior part, and at the upper and lower edges; but near the centre and at the posterior part a synovial membrane often intervenes between them.

TABLE OF THE ARTERIES OF THE ABDOMEN.

THE ABDOMINAL AORTA gives off

- 1. Phrenic.
- 2. cœliac axis *
  - Coronary
    - Œsophageal
    - gastric.
  - hepatic
    - Superior pyloric.
    - gastro duodenal
      - Inferior pyloric
      - right gastro-epiploic
      - pancreatico-duodenal.
    - left hepatic branch
    - right hepatic branch
      - Cystic.
  - splenic
    - pancreatic
    - vasa brevia
    - splenic
    - left gastro-epiploic.
- 3. superior mesenteric*
  - Pancreatic
  - intestinal
  - ilio-colic
  - right colic
  - middle colic.
- 4. middle capsular
- 5. renal
- 6. spermatic
- 7. inferior mesenteric*
  - Left colic
  - sigmoid
  - superior hæmorrhoidal.
- 8. lumbar
- 9. middle sacral *
- 10. common iliac.
  - External iliac
    - Epigastric
      - Pubic branch
      - anastomotic
      - cremasteric.
    - circumflex iliac
  - internal iliac
    - Parietal branches
      - Ilio-lumbar
      - lateral sacral
      - gluteal
        - Superficial
        - deep.
      - sciatic
        - Coccygeal
        - comes nervi ischiadici
        - muscular.
      - pudic
        - Visceral
        - inferior hæmorrhoidal
        - superficial perinæal
        - transverse perinæal
        - artery of the bulb
        - to corpus cavernosum
        - dorsal artery.
      - obturator
        - Articular.
    - visceral branches
      - Middle hæmorrhoidal
      - vesical
      - uterine
      - vaginal.

* The branches marked with an asterisk are single.

TABLE OF THE VEINS OF THE ABDOMEN.

- INFERIOR VENA CAVA receives -
  - 1. Common iliac - -
    - Internal iliac - -
      - Visceral branches -
        - Hæmorrhoidal plexus.
        - vesico-prostatic plexus - -
          - Vesical
          - dorsal of the penis
          - deep veins of the penis.
        - uterine
        - vaginal.
      - parietal branches -
        - Obturator
        - pudic - -
          - Veins of corpus cavernosum
          - of the bulb
          - transverse perinæal
          - superficial perinæal
          - inferior hæmorrhoidal.
        - sciatic - -
          - coccygeal
          - comes nervi ischiadici
          - muscular.
        - gluteal.
    - external iliac
      - Epigastric
      - circumflex iliac.
    - ilio-lumbar
    - lateral sacral
    - middle sacral into the left.
  - 2. vertebro-lumbar.
  - 3. right spermatic.
  - 4. renal - -
    - Left capsular
    - left spermatic.
  - 5. right capsular
  - 6. diaphragmatic
  - 7. vena portæ by means of the hepatic veins -
    - Splenic -
      - Splenic branches
      - vasa brevia
      - pancreatic
      - left gastro-epiploic.
      - inferior mesenteric - -
        - Left colic
        - sigmoid
        - superior hæmorrhoidal.
    - superior mesenteric
      - Intestinal
      - ilio-colic
      - right colic
      - middle colic
      - right gastro-epiploic
      - pancreatic.
    - coronary
    - cystic.

TABLE OF THE SPINAL NERVES IN THE ABDOMEN.

- LUMBAR SPINAL NERVES divide into - -
  - Posterior branches
    - Internal - Muscular.
    - external - Muscular cutaneous.
  - Anterior branches; of these the four first end in the LUMBAR PLEXUS*, which supplies - -
    - Ilio-hypogastric
      - Cutaneous of the ilium
      - hypogastric branch.
    - Ilio-inguinal - To integuments of the groin.
    - external cutaneous - - To integuments of the thigh.
    - genito-crural -
      - Genital branch
      - crural branch.
    - anterior-crural -
      - Branches inside the pelvis
        - To the iliacus muscle.
        - To the femoral artery.
      - Branches outside the pelvis - are noticed in the thigh.
    - obturator - Accessory - Other offsets are described in the thigh.

- SACRAL SPINAL NERVES divide into - -
  - Posterior branches unite together and give off - Muscular and cutaneous filaments.
  - The anterior branches of the four superior unite with the lumbo-sacral in the SACRAL PLEXUS †, and furnish
    - Branches inside the pelvis -
      - Visceral
      - to levator ani
      - to obturator internus
      - to the pyriformis
    - branches outside the pelvis
      - pudic - -
        - Inferior hæmorrhoidal
        - superficial perinæal—(*anterior and posterior*)
        - muscular
        - to the bulb
        - dorsal of the penis.
      - inferior hæmorrhoidal (*sometimes*).
      - To the superior gemellus
      - to the inferior gemellus and the quadratus
      - articular
      - small sciatic
      - great sciatic
        - (To the superior gemellus … great sciatic:) these are described in the thigh.

* The lumbo-sacral gives off the superior gluteal nerve.

† The other nerves are described at p. 559.

TABLE OF THE SYMPATHETIC NERVE OF THE ABDOMEN.

SOLAR PLEXUS * or prevertebral centre of the abdomen, furnishes the following plexuses:	Diaphragmatic		
	cœliac	Coronary plexus	
		hepatic	Pyloric right gastro-epiploic gastro-duodenal cystic.
		splenic	Left gastro-epiploic pancreatic.
	superior mesenteric	Offsets to small and large intestine.	
	supra-renal		
	renal	Spermatic plexus, filaments to the.	
	aortic	Hypogastric.	
	spermatic		
	inferior mesenteric	Offsets to the large intestine Superior hæmorrhoidal.	

HYPOGASTRIC PLEXUS †, ends in the pelvic plexus on each side, which gives the following plexuses:	Inferior hæmorrhoidal	
	vesical	Prostatic cavernous deferential to vesiculæ seminales.
	uterine	
	vaginal.	

GANGLIATED CORD of the sympathetic in the abdomen supplies.	External branches	To the lumbar and sacral spinal nerves.
	internal	To aortic plexus to hypogastric plexus to join around middle sacral artery between the cords on the coccyx, in the *ganglion impar*.

* This receives: Great splanchnic nerves; part of small splanchnic; offset of pneumo-gastric.

† This is joined above by: The aortic plexus; filaments from the lumbar ganglia.

PNEUMO-GASTRIC NERVE IN THE ABDOMEN.

Pneumo-gastric	Right	Coronary branches to the back of the stomach filaments to join the cœliac and splenic plexuses.
	left	Coronary branches to the front of the stomach and to the hepatic plexus.

CHAPTER IX.

DISSECTION OF THE LOWER LIMB.

SECTION I.

THE FRONT OF THE THIGH.

ALL the parts described in Section I. are to be examined before the time for turning the body has arrived. Directions.

Position. — During the dissection of the front of the thigh the body should lie on the back, with a block of a suitable size beneath the pelvis, and the lower limbs should hang over the end of the dissecting table. Each limb is to be rotated outwards, so as to make evident a hollow at the upper part of the thigh, and is to be supported in a half bent position by means of a stool beneath the foot. Position of the body.

Surface marking. — Before any of the integument is removed from the limb, the student is to observe the chief markings and eminences on the surface of the thigh. Objects on the surface.

The limit between the thigh and the abdomen is marked on the outer side by the convexity of the crest of the innominate bone, which subsides behind in the sacrum and coccyx; and on the inner side by the projection of the os pubis, from which a line of bone (rami of the pubis and ischium) may be traced backwards along the inner and upper part of the limb to the tuberosity of the ischium. Whilst in front the line of division is indicated by the firm band of Poupart's ligament intervening between the crest of the ilium and the pubes. On the anterior aspect of the thigh, and close to Poupart's ligament, is a slight hollow, corresponding to the triangular space of this part, in which the Prominences limiting the thigh above. Hollow of Scarpa's space.

large vessels of the limb are contained; and extending thence obliquely along the inner side of the limb, is a slight depression marking the situation of the femoral artery, where it is covered by the sartorius muscle. But the position of this arterial trunk may be indicated on the surface by a line from the centre of Poupart's ligament to the inner side of the patella. On the outer side of the thigh, about four inches below the crest of the ilium and the same distance from its anterior part, the student will be able to recognise easily the well marked projection of the great trochanter, which is so valuable a guide to the surgeon in ascertaining the existence of fracture of the upper part of the femur, or the dislocation of the head of that bone from its articular cavity. In a thin body the head of the femur may be felt by rotating the limb inwards and outwards, whilst the thumb of one hand is placed in the hollow below Poupart's ligament, and the fingers behind the great trochanter.

Groove over femoral artery.

Position of great trochanter.

Head of the femur.

At the knee the outline of the several bones that enter into the formation of the joint may be traced with ease. Thus, in front of the joint, when it is half bent, is the rounded prominent patella, which is firmly fixed whilst the limb is kept in the same position, but is moved with great freedom when the joint is extended so as to relax the muscles that are inserted into it. On each side of the patella is the projection of the condyle of the femur, but that on the inner side is the largest. If the fingers are passed along the sides of the patella whilst the joint is half bent, they will be conducted by the condyles of the femur to the tuberosities of the head of the tibia, and will recognise a slight hollow between the two. Behind the joint is a slight depression over the situation of the ham or popliteal space, whose firm lateral boundaries are formed chiefly by the tendons of the flexor muscles of the leg (ham-strings).

Bony eminences of knee.

Patella.

Condyles of the femur.

Tuberosities of the tibia.

The ham behind.

Dissection. — With the position of the limb the same as before directed, the student begins the dissection with the examination of the subcutaneous cellular layer and its vessels; and he is to be careful, whilst making the cuts in the skin, not to sink the scalpel too deeply. At first the integument is to be reflected only from the hollow on the front of the thigh close below Poupart's ligament.

Take up the skin at the top of the thigh.

To raise the skin from this part an incision of about four inches in length is to be made from the spine of the pubes along the inner border of the thigh: from its lower end another cut is to be directed outwards across the front of the limb to the outer aspect; and from its upper end the knife is to be carried along the line of Poupart's ligament as far as the crest of the innominate bone. The piece of skin included by the lines above stated is to be raised and turned outwards, without taking with it the subcutaneous fat

The *superficial fascia* now seen is only part of the structure that forms a general investment for the limb, and is constructed of a network of areolar tissue, with fat or adipose tissue amongst the meshes thereof. As a part of the common covering, it will be found continuous with that of the contiguous regions, so that it may be followed inwards to the scrotum or labium, and upwards on the abdomen. Its thickness varies in different bodies, according to the quantity of fat deposited in it; and at the upper part of the thigh it is divided into two strata (superficial and deep) by some cutaneous vessels and inguinal glands. The superficial of the two layers is now apparent by the removal of the skin, but its connections will be made more evident after the following dissection.

Superficial fascia, how formed; thickness varies; it is divided into two strata by vessels.

Dissection.— To reflect the superficial stratum of the fascia, use the same incisions as those in the skin; and begin the separation from the subjacent structures at the lower part, where the large saphenous vein, and a condensed or membranous appearance on the under surface, will mark the depth of the stratum. The handle of the scalpel may be advantageously employed in raising the fascia along the middle line of the limb; but, where vessels and glands are not found, viz., along the outer and inner borders of the thigh, the separation of the superficial fascia into two layers cannot be made.

To raise the superficial stratum.

The *subcutaneous layer* of this fascia decreases in thickness near Poupart's ligament, becoming more fibrous at the same spot; and on its under aspect is a smooth and membranous surface. It conceals the superficial vessels and inguinal glands, and is separated by these from Poupart's ligament, so that it is unconnected to that band as it passes

Subcutaneous layer of the fascia is not united with

Poupart's ligament. upwards to the abdomen, and is readily moved on it either upwards or downwards.

The superficial vessels in the fascia to be seen. *Dissection.* — The inguinal glands and the superficial vessels are next to be laid bare by the removal of the surrounding fat, but the student is to be careful not to destroy the deeper, very thin layer of the superficial fascia which is beneath them, chiefly to the inner side of the centre of the limb. Three sets of vessels will be found in this dissection: one set (artery and vein) are directed inwards to the pubes, and named external pudic; another, upwards over Poupart's ligament, viz., the superficial epigastric; and the third, or the superficial circumflex iliac, appear near the outer border of the limb. The large vein in the middle line of the limb to which the branches converge, is the internal saphenous. A small nerve, the ilio-inguinal, is to be sought on the inner side of the saphenous vein, and close to the pubes; and one of the terminal branches of the genito-crural nerve may be found a little outside the vein. Some of the small lymphatic vessels may be traced from gland to gland.

The arteries from the femoral. SUPERFICIAL VESSELS.—The small cutaneous arteries that are now laid bare are the highest branches of the femoral artery, and are furnished by that trunk as soon as it appears in the thigh.

Veins join the saphenous. They pierce the deep fascia of the limb (fascia lata), and are distributed in the integuments. A vein accompanies each artery, having the same name as its companion vessel, and ends in the upper part of the saphenous vein; but the description of these veins will be given in a subsequent page.

One external pudic artery; The *external pudic* artery (superior) crosses the spermatic cord in its course inwards, and ends in the integument of the penis and scrotum, anastomosing in those parts with offsets of the internal pudic artery. another beneath the fascia. Another external pudic branch (inferior) pierces the fascia lata at the inner border of the thigh, and ramifies also in the scrotum. In the female these branches supply the labium pudendi.

Superficial epigastric. The *superficial epigastric* artery passes over Poupart's ligament to the lower part of the abdomen (p. 418.), and anastomoses with branches of the deep epigastric artery.

Superficial iliac. The *superficial circumflex iliac* artery is the smallest of the three branches, and appears commonly on the outer border of the

thigh, near the crest of the ilium, where it is distributed in the integument.

The *superficial inguinal glands* are arranged in two lines; one set lies across the thigh, near Poupart's ligament, and the other along the side of the saphenous vein. In the lower or longitudinal collection the glands are larger than in the other, and receive the lymphatic vessels from the surface of the lower limb; whilst the upper or transverse set are joined by the lymphatics of the penis and of the lower part of the abdomen. The glands vary much in both number and size, and not unfrequently those by the side of the vein are united together.

Inguinal glands; two sets, which receive different lymphatics.

Dissection.—Separate now the deeper layer of the superficial fascia from the subjacent strong fascia (fascia lata), using the same incisions as for the detaching of the subcutaneous stratum, except that the lower cut across the thigh is not to be made so far down. The handle of the scalpel is to be employed in the separation, and the dissector is to endeavour to avoid cutting the nerves and vessels. Internal to the saphenous vein a thin membrane can be easily raised, so as to expose the margin of an aperture in the fascia lata (saphenous) that is concealed by it, but external to that vessel there scarcely exists a continuous layer distinct from the fascia lata.

Raise the deep stratum of the superficial fascia.

The *deeper layer* of the *superficial fascia* is a very thin membraniform stratum, which is most apparent near Poupart's ligament, and on the inner side of the saphenous vein. About one inch below the ligament it conceals the large opening in the fascia lata, that transmits the saphenous vein and some of the ducts of the lymphatic glands. As it stretches across the opening it is connected to the circumference internally by a loose cellular membrane, but externally by firm fibrous bands; and it is also connected with the side of the loose sheath of the femoral vessels that appears through that aperture. The part of the fascia that is placed over the opening for the saphenous vein is perforated by many small apertures for the transmission of the ducts of the glands, and is sometimes named *cribriform* fascia, from its sieve-like appearance. In a femoral hernia

Deep part of the superficial fascia covers saphenous opening, and is thus named

cribriform fascia.

the part of this deep layer of the fascia that is over the opening referred to, is projected forwards by the protruding gut, and forms one of the coverings.

To take the skin from the front of the thigh,

and follow saphenous vein.

Dissection. — Now the student has observed the disposition of the superficial fascia near Poupart's ligament, he may proceed to examine the remainder of this subcutaneous covering of the thigh, together with the vessels and nerves in it. To raise the skin from the front of the thigh, make a cut along the centre of the limb, continuing the same over the knee-joint to rather below the tuberosity of the tibia, and at its extremity make a transverse incision, which is to reach farthest on the inner side. The saphenous vein is first to be traced out as far as the skin is reflected, but in removing the tissue from it the student should be careful of branches of the internal cutaneous nerve that lie along it.

Cutaneous nerves of front of thigh,

The cutaneous nerves of the front of the thigh will be found in the fat in the following positions: — On the outer margin is the external cutaneous nerve; in the centre are the branches of the middle cutaneous nerve; whilst at the inner margin lie the ramifications of the internal cutaneous nerve, one small offset appearing near the upper part of the thigh, one or more about the middle, and one of the terminal branches (anterior) about the lower third.

and on side of the knee.

On the inner side of the knee three other offsets of cutaneous nerves are to be looked for: one is a branch of the great saphenous, which is directed to the front of the patella; another is the trunk of the great saphenous nerve, which lies by the side of the vein of the same name, close to the lower part of the space now dissected; and the third is a terminal branch (inner) of the internal cutaneous nerve, that is close behind the preceding, and communicates with it. Small cutaneous arteries accompany the nerves.

Superficial veins.

Superficial Veins. — All the veins on the anterior and inner aspects of the thigh are collected into one trunk, that is named saphenous from the readiness with which it is detected on the surface.

Internal saphenous vein in thigh

The *internal saphenous* vein is the cutaneous vessel of the inner side and front of the lower limb, and extends from the foot to the upper part of the thigh, where it joins the femoral vein. In the part of its course now seen the vessel, inferiorly, is somewhat behind the knee-joint; but as it

ascends to its termination it is directed along the inner side and the front of the thigh. Near Poupart's ligament it pierces the fascia lata by a special opening named saphenous, and enters the deep vein of the limb. Superficial branches join it both externally and internally, but some deep veins likewise open into it; and near Poupart's ligament three superficial veins, corresponding to the arteries in that situation, viz. superficial pudic, epigastric, and circumflex iliac, terminate in it. Most frequently the veins of the inner side and back of the thigh are united into one branch that enters the saphenous trunk near the aperture in the fascia lata; and sometimes those on the outer side of the thigh are collected together in a similar way, so as to give origin to three large veins on the front of the thigh at its upper part.

pierces fascia lata to join the femoral.

Veins joining it

may form large trunks at the top of the thigh.

Some unnamed *cutaneous* arteries are distributed to the integuments along with the nerves; and the superficial branch of the anastomotic artery (p. 619.) accompanies the saphenous nerve.

Other cutaneous arteries.

Cutaneous Nerves.—The cutaneous nerves of the thigh are derived from branches of the lumbar plexus (p. 528.), and are distributed in greater abundance on the inner than on the outer margin of the limb.

Cutaneous nerves.

The *ilio-inguinal* nerve is small in size, and reaches the surface by passing through the external abdominal ring; it supplies the scrotum, and ends in the contiguous part of the thigh, internal to the saphenous vein.

Ilio-inguinal is near scrotum.

The *crural* branch of the *genito-crural* nerve pierces the fascia lata near Poupart's ligament, and rather external to the line of the femoral artery. After the nerve has become superficial, it communicates with the middle cutaneous nerve, and extends on the anterior aspect of the thigh as far as midway between the knee and the pelvis. Occasionally this branch is of large size, and, reaching the outer side of the limb, takes the place of branches of the external cutaneous nerve.

Genito-crural is on front of thigh as far as the middle.

The *external cutaneous* nerve is distributed on the outer aspect of the limb. At first it is contained in a prominent ridge of the fascia lata on the outer margin of the thigh, where it divides into an anterior and a posterior branch. The *posterior* branch is soon subdivided into two or three others, which arch backwards, sup-

External cutaneous

is spent on the outer

part of the thigh by two branches. plying the integuments of the outer part of the thigh as low as the middle, and the highest offsets are crossed by branches of the last dorsal nerve. The *anterior* branch extends to the outer surface of the thigh in its lower half. It appears on the surface of the fascia lata, about four inches from Poupart's ligament, and as it is continued to the knee, it distributes branches laterally, but the most numerous and the largest in size towards the outer and posterior surfaces. Near the knee it sometimes communicates with the branch of the great saphenous nerve.

Middle cutaneous is on front of the thigh, and reaches the knee. The *middle cutaneous* nerve is an offset from the anterior crural to the centre of the anterior part of the thigh, and divides into two branches that may pierce the fascia at separate spots. The nerve is transmitted through the fascia lata about three inches from Poupart's ligament, and its branches are continued along the front of the thigh to the knee, where it communicates with the offset of the great saphenous nerve over the patella. In the superficial fascia this nerve is united with the genito-crural and internal cutaneous nerves. In some instances the nerve is inclined to the inner side of the knee, and is substituted for a branch (anterior) of the following nerve.

Internal cutaneous is divided into two. The *internal cutaneous* nerve is derived from the anterior crural trunk, like the preceding, and is furnished to all the inner side of the thigh. It is divided into two branches (anterior and inner) that perforate the fascia in separate places.

The anterior branch extends to knee along the septum. *a.* The *anterior* branch becomes cutaneous in the lower third of the thigh in the line of the inner intermuscular septum, along or somewhat behind which it is continued to the knee. This branch is distributed in the integument of the lower third of the thigh at its inner part, and in that over the patella and the inner side of the knee-joint, and is united with the branch of the internal saphenous nerve. Occasionally this part of the nerve is found below the level of the joint in the position of the branch to the patella from the internal saphenous, whose place it takes; and in that case it is larger than usual, and is joined by a small offset from the saphenous nerve.

The inner ends in upper part of the leg. *b.* The *inner* branch perforates the fascia at the inner side of the knee behind the internal saphenous nerve, with which it communicates, and furnishes offsets to the lower part of the thigh and to the upper half of the leg on the inner surface.

Other small twigs to inner Other small cutaneous branches come either from the trunk, or from the two final branches of the internal cutaneous nerve, and appear by the side of the saphenous vein, after piercing the fascia lata. One or two

come into view near the upper part of the vein, and reach as far as the middle of the thigh; and one, of larger size than the rest, appears where the others cease, and extends as far as the knee. These cutaneous offsets usually communicate. part of the thigh.

The *internal saphenous* nerve is also a branch of the anterior crural, and is continued to the foot, but only a little part of the nerve is now visible. The nerve pierces the fascia on the inner side of the knee, and after communicating with the inner branch of the internal cutaneous, gives forwards some offsets to the front of the knee, and then accompanies the saphenous vein to the leg and foot. Internal saphenous appears by the knee and passes to the leg.

One branch of the saphenous nerve (*patellar*) appears on the surface of the fascia, higher on the side of the joint than the trunk from which it springs. It is soon joined by the internal cutaneous nerve, and ends in many branches over the patella; its ramifications communicate with offsets from the external and middle cutaneous nerves, and from the trunk of the saphenous nerve, and form an interlacement (*plexus patellæ*) over the joint. When this branch is small its place is taken by the internal cutaneous nerve. A branch from it over the patella forms a plexus with others.

Dissection.—Let the fat be now removed from the surface of the fascia lata, without however destroying the cutaneous nerves, and let the inguinal glands be likewise taken away. At the upper part of the thigh the student should endeavour to define the margin of the saphenous opening by detaching the bands of fibrous tissue that pass from the outer side of that aperture to be blended with the superficial fascia. After those bands are broken through, the handle of the scalpel being chiefly used for the purpose, the outer semilunar margin of the saphenous opening comes into view, but the student is not to expect it to be so defined as it is represented in drawings. Clean the surface of the fascia lata, and define saphenous opening.

The *fascia lata* is the special deep aponeurosis of the thigh which surrounds the limb, giving it a firm sheath, and sends inwards septa between the different muscles. This membranous investment is of a bluish white colour, and of very variable thickness, though it is always stronger on the outer than on the inner aspect of the limb, in consequence of the insertion into it of the gluteus maximus and tensor vaginæ femoris muscles. In fat bodies it is sometimes so slight as to be taken away with the superficial fascia. Fascia lata surrounds limb; strength varies.

Numerous apertures exist in the fascia for the trans- Aper-

tures in it. mission of the cutaneous nerves and vessels, of which the largest is the opening near Poupart's ligament for the passage of the internal saphenous vein. Most of the processes, prolonged from the under surface, form fibrous sheaths for the several muscles. But some of these are larger than the rest, and are named specially intermuscular septa; thus two, outer and inner, are fixed to the femur, so as to limit on each side the extensors of the leg, and a third intervenes between the adductors and the flexors of the leg. The position of these partitions is marked on the surface by lines somewhat whiter than the rest of the membrane.

Processes between the muscles.

Connected with bone at upper part of thigh.

At the upper part of the thigh the fascia is fixed to the prominent bony parts of the pelvis. Around the circumference of the limb it will be found connected externally with the crest of the ilium; in the middle line behind with the lower end of the sacrum and with the coccyx; internally with the ramus of the ischium and with the os pubis; and in front with Poupart's ligament, between the pubes and the iliac crest. At the lower part of the thigh the fascia lata passes uninterruptedly to the leg behind the knee-joint, but in front of the articulation it is blended with an expansion from the extensor muscles, and is continued over the patella, but separated by a bursa, to be inserted into the heads of the tibia and fibula.

Difference at lower part.

Cover the fascia except above.

Dissection.—The flaps of skin that were removed from the front of the thigh to follow the cutaneous vessels and nerves are now to be replaced, and the saphenous opening is to be next looked to.

Saphenous opening; situation, form, and size.

The *saphenous opening* in the fascia lata receives its appellation from transmitting the saphenous vein. The aperture is oval in form, and is situate rather to the inner side of the middle line of the thigh; it measures about half an inch in width and one inch and a half in length. Its upper part (superior cornu) is at Poupart's ligament; and its lower part (inferior cornu) is distant from that structure about one inch and a half, and presents a well defined margin.

Inner margin is not sharp;

On the inner side the opening is deficient in a firm or sharp border, for the fascia that constructs it at this spot is stretched over a flat subjacent muscle (pectineus), and is

posterior to the level of the femoral vessels, beneath which it lies. But the outer side is much stronger, and has a semilunar border, whose concavity is turned downwards and inwards. This outer edge is named, from its shape, *falciform* border or margin of the saphenous opening (falciform process of Burns); it is superficial to the femoral vessels, and is connected by fibrous bands to their sheath, and to the deep layer of the superficial fascia. If the outer edge is traced upwards, it will be found to arch over the femoral vessels to their inner side, and to be blended with the base of Gimbernat's ligament (part of the insertion of Poupart's ligament); its upper end, or that internal to the vessels, viz. about one fourth, has been known as the *femoral* ligament. The rigidity of the margin of the saphenous opening is much influenced by the position of the limb; for if the finger is placed beneath the upper part of the falciform border whilst the limb is moved in different directions, the dissector will perceive that this band is most unyielding when the limb is extended and rotated outwards, and most relaxed when the thigh is flexed and turned in the opposite direction.

outer is firm and semilunar,

and arches to join Gimbernat's ligament.

Tenseness of the margins depends on the position of the limb.

Through the lower part of the saphenous opening the saphenous vein and the ducts of the inguinal glands are transmitted; and through the upper part, close to the falciform edge, the femoral hernia projects from the canal by which it leaves the cavity of the abdomen.

Parts transmitted through the opening.

From the importance of a knowledge of the form, situation, and construction of the saphenous opening anatomists have been led to describe with much minuteness the fascia lata in the upper third of the thigh. For instance, they have given different names to the fascia on opposite sides of the opening, as if there was a distinct structure in each place; thus the piece external to the opening has been called iliac part of the fascia lata, from its attachment to the os ilii; whilst that on the inner side, which is fixed to the os pubis, has been named the pubic part of the same fascia, and has been described as passing outwards over the pectineus muscle to be blended with that covering the psoas. Lastly, the opening itself is said to be formed by the splitting of the fascia lata into the

Description of the fascia at the top of the thigh,

and of the form-

ation of the opening. two parts above mentioned; and the attachments and destination of these are specially detailed.

Anatomy of parts concerned in a femoral hernia. *Parts concerned in femoral hernia.* —Besides the saphenous opening, which is the aperture of exit of a femoral hernia from the canal through which it leaves the abdomen, the dissector has to study the under-mentioned parts to obtain a knowledge of the structures amongst which the hernial protrusion is situate, viz. the crural arch and Gimbernat's ligament, the crural sheath, the crural canal and the crural ring, together with a partition between the thigh and the abdomen.

Dissection to see a sheath around femoral vessels. *Dissection.*—To examine Poupart's ligament and a loose sheath of membrane that surrounds the femoral vessels, reflect the piece of the fascia lata that forms the falciform border of the saphenous opening by the following incisions. One cut should be begun close to Poupart's ligament, near the edge of the falciform border, and be carried outwards parallel to the ligament for one inch and a half; the other should be directed obliquely downwards, from the termination of the first to a little below the inferior cornu of the opening. When the fascia is turned inwards and some fat removed, the tube of membrane (crural sheath) is brought into view as it descends beneath Poupart's ligament. With the handle of the scalpel separate carefully the sheath from the fascia lata beneath, and from the ligament in front of it; and define Gimbernat's ligament on the inner side of the sheath, to which the upper end of the falciform border is united.

The crural arch; *Poupart's ligament*, or the crural arch, is a firm band of the aponeurosis of the external oblique muscle of the abdomen, which stretches from the front of the crest of the
attachments; ilium (anterior superior spinous process) to the os pubis (p.
form; 423.). When viewed from the surface of the body, the direction of the arch is not straight between its bony attachments, but is curved downwards towards the thigh. Its outer half is oblique as long as the fascia lata remains uncut; but its inner half is almost horizontal, and widens as it approaches the pubes, where it is inserted into the spine, as well as into the pectineal line of that bone for about an inch,
parts closing hollow beneath. forming Gimbernat's ligament. The space beneath the crural arch, between it and the innominate bone, is closed

by parts passing from the abdomen to the thigh, and is larger in the female than in the male. The outer half of the interval is filled by the fleshy psoas and iliacus muscles, to which the arch is closely bound by fascia, so as almost to prevent any protrusion of intestine at this spot; and the inner half of the space is occupied by the femoral vessels and their sheath.

Gimbernat's ligament.—Between the posterior border of the crural arch and the pubes is a piece of the tendinous insertion of that structure into the bone, which is named Gimbernat's ligament. When Poupart's ligament is in its natural position, this piece of the tendon appears triangular in form, and about one inch in length. Its apex is at the spine of the pubes, and its base, which is in contact with the femoral sheath, is blended with the fascia lata,—the part that forms the outer margin of the saphenous opening. By one margin (anterior) it is continuous with the crural arch, and by the opposite it is fixed to the pectineal line of the pubes. In the erect position of the body the ligament is almost horizontal, and one surface is directed upwards to the abdominal cavity, whilst the other is turned towards the thigh. On forcibly raising the crural arch, the continuation of Gimbernat's ligament with that band will plainly appear. Gimbernat's ligament is part of the insertion of Poupart's. Form, situation, and connections.

The *femoral* or *crural sheath* is a loose tube of membrane surrounding the femoral vessels, that has the form of a funnel sloped unequally on the sides. The wide part of the tube is turned upwards, and the narrow part ceases about two inches below Poupart's ligament, by being blended with the common cellular sheath of the blood-vessels. Its outer border is nearly straight, and is perforated by the genito-crural nerve. Its inner border is oblique, and is pierced by the lymphatics and the saphenous vein; it is this part of the sheath that is seen through the saphenous opening, and is connected to both the falciform margin and the superficial fascia. In front of the sheath and behind it is the fascia lata of the thigh. The tube of membrane is derived in this way from the fasciæ that line the abdomen; the anterior part is prolonged beneath Poupart's ligament into the fascia transversalis, and the posterior half is continued into the fascia iliaca (p. 444.). Crural sheath. Shape and connections; how formed.

Deep crural arch. Across the front of the crural sheath and below the arch of Poupart's ligament, is a thickened band of the fascia transversalis, which has been named *deep crural* arch. This band has been supposed to occasion sometimes the stricture of the subjacent gut in a femoral hernia. A notice of it is given with the description of the fascia transversalis (p. 433.).

Open the crural sheath. *Dissection.*—The student should open the sheath by an incision across the front, and should raise the loose anterior part with hooks. A piece of the cellular investment of the femoral vessels is to be cut out over the situation of each, and two thin partitions are to be defined; one of these is internal to the vein separating it from a gland, the other is between the vein and artery. A cellular stratum may be seen to be placed over the upper aperture of the sheath, which closes it towards the abdomen.

Contents of the sheath. The *interior* of the *crural sheath* is occupied by the femoral vessels, and is divided into three compartments by two partitions that pass from the front to the back, one being internal to the femoral vein, and the other between the two large vessels. In the outer compartment is the femoral artery, close to the side of the sheath; in the middle one is the femoral vein; and in the inner one is only a lymphatic gland. The femoral vessels are further surrounded by their own cellular covering, which is distinct from the crural or femoral sheath now described.

Space divided into three parts.

The inner of the three spaces is the crural canal. *Crural canal.* — This term is applied to the innermost space in the interior of the crural sheath, which is occupied by a lymphatic gland. Its extent is about a quarter of an inch, for it reaches only from the base of Gimbernat's ligament to the upper cornu of the saphenous opening. Anterior to the sheath at this part are Poupart's ligament and the upper end of the falciform margin of the saphenous opening, whilst behind it is the pectineus muscle, covered by fascia lata. On the inner side is Gimbernat's ligament, and on the outer side is situate the femoral vein. The aperture by which it communicates above with the cavity of the abdomen is named the crural ring. Through this canal or space the intestine in femoral hernia passes from the abdomen.

Extent and parts around it.

Some writers apply the term crural canal to the whole of the space in the interior of the crural or femoral sheath, and describe therefore the femoral vessels as being in the crural canal; but the appellation is here confined, as above stated, to the space inside the sheath which is internal to the vessels, and through which a piece of intestine descends. Definition of term crural canal here employed.

The *crural* or *femoral ring* is the upper opening of the crural canal towards the abdominal cavity.* It is on a level with the base of Gimbernat's ligament, and is larger in the female than in the male. It is oval in shape; and its greatest measurement is from side to side, in which direction it equals about half an inch. The structures that surround the opening are nearly the same as those bounding the crural canal, viz. in front is the crural arch with the spermatic cord in the male, and the round ligament in the female; behind is the os pubis, covered by fascia lata; on the outside is the femoral vein; and on the inside is Gimbernat's ligament. The position of the several vessels along the sides of the ring is stated at p. 445. Crural ring. Situation and form. Structures around.

Septum crurale. — The small part of the subperitoneal layer of fat, which is placed over the opening of the crural ring, has been named crural septum by M. Cloquet, from its position between the thigh and the abdomen. The situation of the partition is now visible, but its characters are ascertained in the dissection of the abdomen (p. 444.). Crural septum; position; how formed.

After having learnt the anatomy of the parts in the thigh amongst which a femoral hernia lies, the student is prepared to understand the course this takes, the coverings it receives, and the seat of its stricture.

Femoral Hernia. — A protrusion of the intestine into the thigh beneath Poupart's ligament constitutes this kind of hernia. In this affection, the gut descends always in the femoral or crural sheath, and commonly on the inner side of Femoral hernia. Definition;

* Gimbernat used the name crural ring, and Mr. Lawrence proposes to call it femoral aperture. Might not the nomenclature employed be made to resemble more that used in describing inguinal hernia, by calling this the internal crural aperture, and the saphenous opening the external crural aperture?

the vein, though occasionally on the outer side of the artery.

course; first vertical, next directed forwards, and then upwards.

Course. — The course of the intestine from the abdomen to the surface of the body is vertical, at first, through the crural ring and along the crural canal as far as the saphenous opening, but it here changes its direction, and comes forwards. If a larger piece of the gut is protruded the hernia again alters its direction and ascends on the abdomen, almost parallel to the first part of its course, in consequence of its progress being easier upwards than downwards on the front of the thigh. A slight consideration of the winding course of the hernia will suggest to the dissector the direction in which attempts should be made to replace the intestine in the abdominal cavity. With the view of making the bowel retrace its course, it will be necessary first to press it down towards the saphenous opening, and afterwards backwards and upwards towards the crural canal and ring. It will be likewise evident, from the previous dissection, that the limb should be raised and rotated inwards during the manipulation, in order that the margin of the saphenous opening, and the other tissues may be relaxed.

By what means it is to be pushed back.

Coverings for the gut from the peritoneum, crural septum, crural sheath, cribriform fascia, fat and skin.

Coverings. — In the course above specified the intestine is clothed by the following structures that are elongated and pushed before it: they are here enumerated from within outwards, in the order in which they are received. First is a covering of the peritoneum lining the abdomen; next one from the crural septum across the crural ring; after this comes a stratum from the femoral sheath, unless the hernia bursts through an aperture in its side; still farther out is a layer of the cribriform fascia; and, lastly, there is an investment of the superficial fat or fascia, together with the skin. From without inwards the order of the different strata will be reversed. The coverings may vary, or be conjoined in different degrees according to the condition of the hernia; for in some instances, as above explained, the prolongation from the femoral sheath is wanting; and in an old hernia the covering derived from the septum crurale is usually united with that from the crural sheath, so as to form one layer, the *fascia propria* of Sir A. Cooper. In general,

The coverings may be altered.

in an operation for the relief of the strangulated bowel, the surgeon, after dividing the subcutaneous fat, may be able to recognise but little of the coverings enumerated by anatomists until he meets with that of the sub-peritoneal fat, or the septum crurale.

The surgeon does not find so many as the anatomist.

Seat of stricture. — The strangulation of a femoral hernia is situate either at the crural ring or at the saphenous opening. If it is in the former spot it is occasioned by the base of Gimbernat's ligament, and will be relieved by an incision into that structure, of a few lines in extent, with the knife directed horizontally. If the constriction is in the lower opening, it will be removed by dividing upwards and inwards the firm band of the falciform margin of that aperture, which arches over the neck of the hernia. The several vessels that may be wounded in attempting to relieve the strangulated intestine are enumerated at page 446.

Place of stricture.

How it is to be removed.

Dissection.— Remove the fascia lata from the hollow in the upper part of the thigh, Scarpa's triangular space, and clean the muscles that bound the space on each side. The remains of the crural sheath are then to be taken from the femoral vessels, and these are to be followed downwards as far as the sartorius muscle. On the outer side of the vessels the divisions of the anterior crural nerve are to be sought, together with the branches of an artery (profunda) which are buried in the fat. All the cellular tissue is to be cleared out of the space; and, in removing it from beneath the femoral artery, the student is to seek for one or two small nerves to the pectineus muscle.

Clean out Scarpa's triangular space.

The *triangular space* in the upper part of the thigh is beneath the hollow observable on the anterior aspect, near Poupart's ligament, and corresponds to the axillary space in the upper limb. Commonly it equals the upper third of the thigh in extent, but its length varies according to the breadth of the sartorius, and the height at which this muscle crosses inwards. The base of the space is at Poupart's ligament, and the apex at the meeting of the sartorius with the adductor longus muscle. Bounding the hollow on the outer side are the conjoined psoas and iliacus for about two inches, and below these is the sartorius; but on its inner side are the pectineus and adductor longus muscles, with a small

Triangular space at top of the thigh; extent; boundaries;

part of the adductor brevis lying between and behind them near the femur. In this interval are contained the femoral artery and vein and the anterior crural nerve, with a considerable quantity of cellular tissue. The femoral artery runs through the centre of the hollow, and supplies some small cutaneous branches, as well as a large deep offset, named profunda. On the inner side of the artery is the vein, which is here joined by the saphenous and profunda veins; and half an inch external to the vessel is the large anterior crural nerve, which is hidden at first between the iliacus and psoas, but afterwards becomes more superficial and divides into branches. A small artery (superficial pudic) is directed inwards across the inner boundary of the triangular space.

Contents. Femoral vessels. Anterior crural nerve and their branches.

Femoral artery; extent; course.

FEMORAL ARTERY. — This vessel is a continuation of the external iliac artery of the abdomen, and reaches from the lower border of Poupart's ligament to the margin of the opening in the adductor magnus muscle. It occupies the front and the inner part of the thigh for only two-thirds of its length, for at the spot mentioned it turns backwards into the ham, and takes the name popliteal. The course of the vessel will be indicated during rotation outwards of the limb, by a line drawn to the inner side of the patella from a point midway between the symphysis pubis and the anterior spine of the ilium. In the upper part of its course the artery is placed in front of the head of the femur, and is comparatively superficial, being uncovered by muscle; but, in the lower part, it lies along the side of the femur, and is beneath the sartorius muscle. This difference in its connections allows of a division of the arterial trunk into two parts; viz., one in the upper, and one in the middle third of the thigh.

Position to the femur. Division into two parts.

The upper part of the artery is superficial. Parts behind it.

The artery in the upper third of the thigh is contained in Scarpa's triangular space, where it is enveloped by the femoral sheath for about two inches, and is covered only by the skin and superficial fascia, and by the fascia lata, with some inguinal glands. At first the artery rests on the psoas muscle; but it is subsequently placed over the pectineus, though at some distance from it in this position of the

limb, and is separated by cellular tissue, and by the profunda vessels and femoral vein. On the inner side of the vessel and behind it, is the femoral vein; and on the outer side is the anterior crural nerve, distant about half an inch near Poupart's ligament, but some of its branches approach the artery near the apex of the containing space. Position of vein and nerve.

The *branches* of this part of the artery are the superficial epigastric and circumflex iliac, two superficial pudic, and the deep femoral branch: the cutaneous offsets have been dissected (p. 600.), with the exception of the following, which is beneath the fascia lata. Branches of this part already seen, except

The external or *superficial pudic* artery (inferior) arises separately from, or in common with the other pudic branch (superior) (p. 600.). The course of this artery is inwards over the pectineus muscle to the scrotum or the labium pudendi, according to the sex; it perforates the fascia lata at the inner border of the thigh to reach its destination. In the integument it anastomoses with branches of the superficial perinæal arteries. one external pudic, which is beneath the fascia,

The *deep femoral* branch, or the *profunda*, is the largest offset of the femoral artery *, and arises from the outer part of that vessel, about one inch and a half below Poupart's ligament (one inch to two inches, Quain). This branch is consumed in the muscles of the thigh, and its distribution will be afterwards ascertained. In the present dissection it is seen to be placed at first over the psoas muscle, where it gives the external circumflex artery to the outer part of the thigh, and then to be directed, with a large vein, beneath the trunks of the femoral vessels to the inner side of the femur. and the profunda. Origin and position in Scarpa's triangle.

Femoral Vein. — The principal vein of the limb has almost the same relative anatomy as the artery in the triangular space in the upper part of the thigh. Its position to the artery is not the same, however, throughout: for beneath Poupart's ligament it is on the inner side of that trunk, and on the same level, and is supported on the os pubis between Femoral vein: first inside the artery,

* Some anatomists apply the term common femoral to the part of the vessel above the origin of the profunda, and give the names superficial and deep femoral to the nearly equal parts into which it divides.

afterwards outside it. the psoas and pectineus muscles; but it soon winds beneath the artery, and appears on the outer side, opposite the upper border of the adductor longus muscle. In this situation the vein receives the internal saphenous and the deep femoral branches.

Peculiarities *Peculiarities in the vessels.* — The deviations from the common condition of the vessels in the triangular space, which will here be noted, refer to change in their position, or to unusual origin of the chief branch of the artery.

in the position of the vein, or the vein may be divided. The position of the vein with respect to the artery may be altered; for the venous trunk may be placed on the inner side through all the triangular space, or it may be slit so as to present a large vein on each side of the artery for a greater or less extent, or one of the two veins may lie over the arterial tube.

Origin of profunda varies from Poupart's ligament to four inches below. The profunda branch, though arising commonly from the femoral artery between one inch and two inches from Poupart's ligament, may approach nearer to that band, or recede farther from it till, as in one example (Quain), it left the parent trunk at the distance of four inches from the ligament; so that in ligaturing the femoral artery in the upper part of the thigh, the thread should be placed four inches below Poupart's ligament, to be free from the disturbing influence of an occasional large offset.

Take the fascia from the front of the thigh. *Dissection.* — To proceed with the deep dissection, open again the flaps of skin down to the knee, and take away the fascia lata to the same extent as the skin. With the leg still in the same position as in the dissection of the other parts, the student is to cut the fascia along the middle line of the thigh and knee, and to reflect it to each side.

Follow out sartorius, In raising the inner piece of the membrane the sartorius muscle should be followed to its insertion into the tibia, and care should be taken of the small nerves along its inner border, viz.: the two and preserve nerves in contact with it. branches of the internal cutaneous above; the great saphenous and its branch below; and the plexus between the saphenous, internal cutaneous, and obturator, at the middle of the thigh. The dissector is to avoid displacing the muscle whilst he is removing its sheath of fascia.

Dissect the adductors, The adductor muscles that are internal to the sartorius are then to be laid bare, and the student is to seek a branch of the obturator nerve, to the plexus before mentioned, beneath the adductor longus muscle, near where this touches the sartorius.

and clean the ex- For the dissection of the extensor muscles of the leg, on the outer side of the sartorius, the knee is to be bent to make tense

their fibres. Whilst removing the fascia lata over the knee-joint, the student will find it inseparably united with an expansion from the tendons of the extensor muscles. One little muscle at the upper part of the thigh, tensor of the fascia, is to be cleaned, and a strip of the fascia lata, corresponding to its width, should be left along the outer aspect of the thigh: behind this slip the fascia is to be divided by one or two transverse cuts, and to be followed backwards to its attachment to the linea aspera of the femur. tensor muscles.

Muscles on the front of the thigh.—In these muscles are included the sartorius, and the extensors of the leg. The most superficial muscle is the sartorius, which arches in a wavy manner over the front of the thigh, passing from the outer to the inner side of the limb, and lies in a hollow between the extensor muscles on the one side, and the adductors on the other. In the set of extensor muscles of the leg are comprised the rectus, vastus externus, and vastus internus and crureus, all which closely surround the femur. Muscles on the front of the thigh.

The SARTORIUS is the longest muscle in the body, and extends from the pelvis to the leg. It *arises* from the upper anterior spinous process of the ilium, and from the interval between this and the inferior process; its fibres constitute a thin, riband-like muscle, which is directed obliquely across the front, but vertically on the inner side of the thigh, as far as the knee, where it ends in a tendon, and is *inserted* into the inner surface of the tibia close to the tuberosity. The muscle is superficial throughout, and is perforated by some cutaneous nerves and vessels. Its upper oblique part forms the outer boundary of the triangular space that contains the femoral artery, and rests on the iliacus, rectus, and adductor longus muscles, as well as on the anterior crural nerve and the femoral vessels. The middle or vertical part of the sartorius lies in a hollow between the vastus internus and the adductor muscles, as low as the opening for the femoral artery; but beyond that point, between the vastus and the inner hamstring muscles, where it bounds the popliteal space at the inner side. Beneath this part of the muscle are the femoral vessels and their accompanying nerves. The lower or tendinous part lies on the internal lateral ligament of the knee-joint, above the tendons of the gracilis and semitendi- Sartorius; origin; course over the thigh; insertion. Connections of the first or oblique part; of the middle part; and of the lower part.

nosus, and separated from them by a synovial membrane. From its upper border an aponeurotic expansion is given to join that from the extensors over the knee, and from its lower border another to blend with the fascia of the leg. Below the tendon the great saphenous nerve appears with its artery, and piercing it is the branch of the same nerve.

Divide the sartorius, and dissect nerves and vessels.

Dissection.—The sartorius is to be turned aside, or cut through if it is necessary, to follow the remaining part of the femoral artery. Beneath the muscle is an aponeurosis between the adductor and extensor muscles, and when this is divided the internal saphenous nerve, and a nerve to the vastus internus muscle that sends an offset to the knee-joint, will come into view. Now the plexus of nerves on the inner side of the thigh can be more completely dissected. Where the femoral artery passes to the back of the limb its small anastomotic branch arises; this is to be pursued in the vastus internus to the knee, and a branch of it is to be traced with the saphenous nerve.

Aponeurosis over the femoral artery; ends below by a defined border.

The *aponeurotic covering* of the femoral vessels exists over those blood-vessels where they are crossed by the sartorius. It is formed of strong fibres that are directed transversely between the vastus internus and the tendons of the adductor muscles. Inferiorly the membranous structure ceases at the opening in the adductor magnus by a defined border, beneath which the saphenous nerve and its artery escape.

Deep part of the femoral artery. Connections.

Femoral artery in the middle of the thigh.—In the middle third of the thigh the femoral artery is more deeply placed than in the upper third, and is covered by the sartorius muscle and the subjacent aponeurosis, in addition to the integuments and the superficial and deep fasciæ. The artery here lies in a hollow, bounded on the one side by the vastus internus, and on the other by the adductor longus and adductor magnus, by which it is conducted to the opening in the last muscle. On the outer side of the artery and close to it is the femoral vein; also on the outer part is the internal saphenous nerve, which is beneath the aponeurosis before described, but is not contained within the cellular sheath of the vessels.

Position of vein and saphenous nerve.

Branches.

Branches.—Only one named branch, anastomotic, springs from this part of the artery, for the other offsets belong to the muscles.

The *anastomotic* branch (arter. anastomotica magna) arises close to the opening in the adductor muscle, and splits at once into two parts, superficial and deep.

Anastomotic, which

a. The *superficial* offset continues with the saphenous nerve to the lower border of the sartorius, and, piercing the fascia lata, ramifies in the integument. *b.* The *deep* or anterior branch is concealed in the fibres of the vastus internus, and descends therein in front of the tendon of the adductor magnus to the inner side of the knee-joint, where it anastomoses with the articular branches of the popliteal and anterior tibial arteries. From it a branch is sent outwards in the substance of the vastus, which forms an arch in front of the lower end of the femur with an offset of the external articular artery, and supplies the joint. The two pieces of the anastomotic artery may be separate at their origin, and spring from distinct parts of the parent trunk.

divides into a superficial and a deep branch.

Muscular branches.—The branches for the supply of the muscles leave the outer part of the femoral artery, and belong mostly to the sartorius and vastus internus.

Muscular branches.

The *femoral vein*, in its connections with the parts around and in its branches, corresponds closely to the femoral artery. Its position with respect to the artery is, as above said, external and close to it.

Femoral vein.

Peculiarities in the trunks of the vessels.—Occasionally the femoral artery is split into two below the origin of the profunda. Four examples of this peculiarity have been met with, but, in all, the trunks became blended into one above the opening in the adductor muscle.

The femoral artery may be divided.

The femoral vein may change its position here, as in the upper part (p. 616.), and be found on the inner side of the artery; or it may be divided into two trunks that lie on the sides of its companion vessel. In some bodies this part of the femoral vein is very small in size, in consequence of the popliteal entering the profunda vein, instead of accompanying the main artery of the limb through the aperture in the adductor magnus.

The vein may be inside the artery; or split; or very small.

Dissection.—The femoral artery and vein are to be cut across below the origin of the profunda, and thrown downwards, preparatory to dissecting the upper part of the vastus internus and crureus. After these are cut, take away all the cellular membrane and the veins from amongst the branches of the profunda artery and anterior crural nerve.

To expose muscles on front of the femur.

Tensor vaginæ femoris arises from pelvis,

The TENSOR VAGINÆ FEMORIS is the smallest and the most external of the outer set of muscles. It takes *origin* from the front of the crest of the ilium, at its outer aspect, and from the superior of the two spinous processes of the same bone, and is *inserted* into the fascia lata about three inches below the great trochanter of the femur. At its origin the muscle is situate between the sartorius and gluteus medius, and its fibres are blended with the latter. Beneath it are the ascending branches of the external circumflex artery, and a branch of the superior gluteal nerve that enters it at the under aspect. A strong sheath of fascia surrounds the muscle.

ends in fascia lata.

Parts around.

Cut through the last muscle.

Dissection. — After the muscle has been learnt, cut through the slip of fascia extending from it to the knee, and, detaching the tensor of the fascia lata from the muscles around, follow the head of the rectus muscle to the pelvis.

Rectus has an origin at the pelvis, which is double,

The RECTUS FEMORIS forms a fleshy prominence on the front of the thigh, and reaches from the pelvis to the head of the tibia. At its *origin* from the pelvis the muscle has two tendinous processes or heads: one arises from the anterior inferior spinous process of the ilium; the other (to be afterwards seen) is fixed into a depression on the back of the ilium, close above the brim of the acetabulum. Fleshy fibres succeed to the tendon, and end inferiorly in another tendon which joins those of the muscles beneath it, and is *inserted* with them into the head of the tibia. The rectus is larger at the middle than at the ends; and the fibres are directed from the centre to the sides, like the feather of a quill, giving rise to that condition called penniform. It is subcutaneous except above, where it is overlaid by the sartorius; but it conceals branches of the external circumflex artery and anterior crural nerve, and rests on the muscular mass of the vastus and crureus. The upper tendon of the muscle reaches farthest on the anterior surface, where the sartorius lies on it, whilst the lower tendon is most extensive on the posterior aspect, or towards the subjacent muscles.

and an insertion into the head of the tibia.

The muscle is penniform, and superficial, except above.

Cut

Dissection.—To see the remaining muscles, cut across the rectus near its lower end, and raise it without injuring the branches of

vessels and nerves beneath it. The muscular mass on the front of the femur is to be divided into two along the situation of some descending vessels and nerves. The muscle external to those vessels is the vastus externus, and the larger mass internal to them is composed of the vastus internus and crureus: the two last muscles are inseparably united; but if the student wishes to make two distinct parts, he must carry the scalpel through the fibres in a line with the inner border of the patella.

the rectus, and separate the extensor muscles.

The VASTUS EXTERNUS is one of the parts of the strong extensor muscle of the leg, and its attachment to the femur is very narrow in comparison with its size and thickness. It has a lengthened *origin* from the outer aspect of the root of the great trochanter; from the outer margin of the linea aspera, as well as from all the line connecting this upwards with the trochanter, but from only two-thirds of the line extending downwards from it to the outer condyle; and, lastly, from the external intermuscular septum. Inferiorly the fibres of the muscle end in an aponeurosis, which is blended with the tendons of the rectus and vastus internus to form a common tendon of *insertion* into the tibia. The muscle is pointed at the upper part, but enlarged below, where it produces the prominence on the outer side of the thigh. Its cutaneous surface is aponeurotic at the upper part, and is covered by the rectus and tensor vaginæ femoris muscles; but the deep surface rests on the vastus and crureus, and on branches of the external circumflex artery and anterior crural nerve.

Vastus externus is thin at the origin; but is thicker below, at its insertion.

Parts in contact with the surfaces.

The VASTUS INTERNUS and CRUREUS are inseparably united, and will be here described as one muscle. The fleshy mass covers the anterior and inner surfaces of the femur, and its extent may be indicated by the following lines: — Upwards it reaches as far as the anterior intertrochanteric line, and downwards to about two inches from the articular end of the femur; outwards, it extends nearly to the linea aspera, but inwards it is fixed to the inner margin of that line as well as to the lines continued from it towards the ends of the bone, viz. to the small trochanter in one direction, and the inner condyle of the femur in the opposite direction. At the lower end of the muscle the fibres terminate in a cuta-

Vastus internus and crureus. One mass on the front of the femur.

Its origin;

insertion

by a common tendon. neous aponeurosis that blends in the common tendon of insertion. The upper part of the muscular mass is buried beneath the sartorius and rectus muscles; but the lower part is superficial, and projects more than the vastus externus at the opposite side of the thigh. The adductor muscles are almost inseparably joined with the vastus along its attachment to the linea aspera.

Upper part is deep, but the lower is superficial.

Small subcrureus muscle; *Subcrureus muscle.* — Beneath the united vastus and crureus, near the knee-joint, is a thin band of pale fibres named as above. It is but a part of the muscle on the front of the femur, which is separated therefrom by a cellular layer. Attached therefore to the front of the femur in its lower third, it ends in aponeurotic fibres on the outer surface of the capsule of the knee-joint.

ends on capsule of the joint.

Lay bare the common tendon of the extensors. *Dissection.* — The common tendon of the vasti and rectus, with the expansion from it over the knee-joint, can be demonstrated by means of an incision along the middle of the patella to the head of the tibia. This cut will allow the thin expansion to be reflected inwards and outwards, so as to lay bare the tendon. A strong transverse band will be likewise seen on each side of the patella; the outer of the two is the strongest.

Tendon of the extensors; The *tendon* of the *extensor muscles* of the leg is common to the rectus, the vastus externus, and the united vastus internus and crureus. Its position is in front of the knee-joint, to which it serves the office of an anterior ligament. Wide above where the muscular fibres terminate, it narrows as it descends over the joint and the patella, and is inserted inferiorly into the prominence of the tuberosity of the tibia. Close to its attachment to the tibia a synovial bursa is beneath it, and in its fibres the patella is contained, like a sesamoid bone in other situations. (See Ligament of the Patella.) From the upper part of the tendon an aponeurotic expansion is derived: this prolongation, which is strongest on the inner side, is united with the fascia lata and the other tendinous offsets to form a capsule around the joint, and is fixed below to the heads of the tibia and fibula.

attachments; bursa beneath. Expansion from it.

Intermuscular septa. *Intermuscular septa.* — The processes of the fascia lata that limit laterally the extensor muscles of the leg are thus

named, and are fixed to the linea aspera, and the lines leading from it to the condyles of the femur. are two:

The *external* septum is the strongest, and reaches from the outer condyle of the femur to the insertion of the gluteus maximus. It is situate between the vastus externus and the short head of the biceps, and is perforated near the outer condyle by the upper external articular artery. The *inner* partition is very thin along the side of the vastus internus, and, between the inner condyle and the linea aspera, its place is supplied by the strong tendon of the adductor magnus. The internal articular artery is transmitted through it to the front of the knee-joint. the outer is the strongest; the inner is indistinct.

The *external circumflex artery* is the chief vessel for the supply of the muscles of the front of the thigh. It arises from the outer side of the profunda (deep femoral) artery, and is directed horizontally outwards through the divisions of the anterior crural nerve, and beneath the sartorius and rectus muscles, to the under surface of the vastus externus, where it ends in branches. Offsets are given from this artery to the rectus and sartorius, and its terminal branches consist of an ascending, a transverse, and a descending set. Artery to the muscles on the front of the thigh. Its branches are—

The ascending branches are about three in number, and are directed beneath the tensor vaginæ femoris to the back of the ilium, where they anastomose with the gluteal artery. an ascending set,

The transverse or middle set, the least numerous and the smallest in size, perforate the vastus externus, and anastomose on the back of the thigh with the sciatic and perforating arteries. a transverse,

The descending branches are the largest, and are distributed to the vasti muscles. One considerable offset enters the vastus externus, and reaches the knee, on which it anastomoses with the external articular arteries. and a descending set.

Peculiarities in this artery are very frequent, both in the trunk and in the branches. Thus the vessel may arise as one trunk from the superficial instead of the deep femoral artery; or as two pieces, which may spring from either of the two femoral trunks, or from both by a branch obtained from each. Varieties in the trunk and branches.

The ANTERIOR CRURAL NERVE is derived from the lumbar plexus (p. 530.), and supplies the muscles and the integument of the front of the thigh, and the integument of the Nerve of the front of the thigh

is divided. inner side of the leg. Soon after the trunk of the nerve leaves the abdomen beneath Poupart's ligament it is flattened, and divided into a superficial or cutaneous, and a deep or muscular part.

From its superficial part arise — A. The *superficial* part of the nerve ends in these three branches: the internal and middle cutaneous of the thigh, and the great saphenous.

middle cutaneous; The *middle cutaneous nerve* perforates the fascia lata, sometimes also the sartorius, about three inches below Poupart's ligament, and extends on the surface of the thigh to the knee. Its cutaneous distribution is described at page 604.

internal cutaneous; The *internal cutaneous nerve* sends two or more small twigs through the fascia lata to the integument of the upper third of the thigh, and then divides in front of the femoral artery, or on its inner side, into the two following branches, anterior and inner. Sometimes these branches, into which which has the nerve ordinarily divides, arise from the anterior crural trunk at separate spots.*

anterior and The *anterior* branch is directed to the inner side of the knee-joint. As far as the middle of the thigh it lies over the sartorius, but it then pierces the fascia lata, and ramifies in the integument as before said (p. 604.).

inner branch The *inner* branch is distributed in the integument of the inner side of the leg, just below the knee, but it remains beneath the fascia lata as far as the knee (p. 604.). Whilst underneath the fascia the nerve lies along the inner border of the sartorius, and joins about the middle of the thigh with branches of the obturator and internal saphenous nerves to form a plexus. When this branch is small it ends in the plexus just mentioned, and in offsets to the inner part of the thigh, instead of being continued onwards to the leg.

Internal The *internal saphenous* nerve is the largest of the three

* The description here given of the distribution of the internal cutaneous nerve has been derived from facts ascertained by repeated careful dissections. It differs from the one in ordinary use, though the same arrangement has been described by me before in the fifth edition of Quain's "*Anatomy*," but without any statement in support of its correctness. — G. V. E.

saphenous nerve

superficial branches; it becomes cutaneous on the inner side of the knee, and accompanies the vein of the same name to the foot (p. 605.). In the thigh the nerve approaches the femoral artery, where this is concealed by the sartorius, and is continued along the outer side of that vessel, beneath the aponeurosis covering the same, as far as the opening in the adductor magnus muscle. At that spot the nerve passes from beneath the aponeurosis, and is continued under the sartorius muscle to the upper part of the leg, to become cutaneous as before said. It supplies two cutaneous offsets whilst it is contained in the thigh beneath the fascia.

becomes cutaneous at the knee;

One of these offsets (*communicating branch*) arises about the middle of the thigh, and crosses inwards beneath the sartorius to join in the plexus between it, the internal cutaneous, and the obturator: this branch is sometimes absent. The other *branch* to the *front* of the *patella* springs from the nerve near the knee-joint, and perforates the sartorius muscle and the fascia lata to end in the integument over the knee (p. 605.).

has a communicating and a patellar offset.

B. The *deep* or *muscular* part of the anterior crural nerve gives branches to all the muscles of the front of the thigh, except the tensor vaginæ femoris, and to one of the adductor muscles, viz. the pectineus.

From the deep part arise

Two slender *nerves* cross beneath the femoral artery and enter the anterior surface of the *pectineus*.

branches to pectineus,

Branches to the *sartorius* are furnished by the middle or by the internal cutaneous nerve, whilst it is in contact with that muscle.

sartorius,

A *nerve* enters the under surface of the *rectus* muscle at the upper part, and divides into branches as it is about to penetrate the fibres.

rectus,

The *nerve* to the *vastus externus* divides into two or more branches as it enters the muscle. From one of these an *articular* filament is continued downwards to the knee-joint, which it enters on the anterior aspect.

vastus externus and knee-joint,

The *nerve* to the *vastus internus* is nearly as large in size as the internal saphenous, in common with which it often arises. To the upper part of the muscle it furnishes one or more branches, and is then continued beneath the aponeurosis covering the femoral vessels as far as the centre of the

and vastus internus.

thigh, where it ends in offsets to the muscle, and in an articular branch to the knee-joint.

Its articular branch to knee. The *articular* branch is prolonged to the inner side of the knee-joint on or in the vastus, and on the tendon of the adductor magnus, and is distributed over the synovial membrane of the front of the articulation: this small nerve accompanies the deep branch of the anastomotic artery.

Nerve of tensor vaginæ. The *branch* of nerve to the *tensor vaginæ femoris* is derived from the superior gluteal (p. 640.), and enters the under surface of the muscle. In the fibres it extends nearly to the lower end.

Dissection of adductor muscles. *Dissection.* — After the examination of the muscles of the front of the thigh with the vessels and nerves that are furnished to them, the student should learn next the adductor muscles and their vessels and nerves. To prepare the muscles, take the cellular tissue from them, and separate the superficial adductors one from another. Let the student be careful of the branches of the obturator nerve in connection with the muscles, those offsets entering both the muscular fibres and the plexus on the inner side of the thigh. Lastly, take the cellular tissue, and the veins that are left, from the profunda and its branches.

The adductor muscles *Muscles on the inner side of the thigh.* — This set of muscles consists of three adductors, viz. adductors longus, brevis, and magnus, with the gracilis and the pectineus; these have the under-mentioned position with respect to one another. and their position. Most internal of all and the longest, is the gracilis, which may moreover be recognised by its slender, riband-like appearance. Superficial to the others, are the pectineus and adductor longus, which are directed obliquely from the pubes to the femur, and bound internally Scarpa's triangular space. Beneath those two the short adductor is placed, and behind all is the adductor magnus.

Gracilis The GRACILIS reaches from the pelvis to the tibia, and is fleshy and riband-like above, but tendinous below. The takes origin from the pelvis, is inserted into tibia. muscle *arises* by an aponeurosis, two to three inches in depth, from the body and the descending ramus of the os pubis, and partly from the ascending ramus of the ischium; and is *inserted* by a flat tendon into the inner surface of the tibia, below the sartorius. At the upper part the muscle is super-

ficial, and is flattened against the adductor magnus, so as to have its borders directed forwards and backwards; but in the lower third of the thigh it intervenes between the sartorius and semi-membranosus muscles, and forms part of the inner boundary of the popliteal space. Its tendon, near the insertion, is above that of the semi-tendinosus, though on the same level, and both lie over the internal lateral ligament, but separated from it by a bursa. An expansion is continued from the tendon to the fascia of the leg, as in the tendons of the sartorius and semi-tendinosus.

Position to other muscles.

Pectineus.

The PECTINEUS is the highest of the muscles that are directed from the pelvis to the inner side of the femur. It has a fleshy origin from the line on the os pubis between the spine and pectineal eminence, and from the triangular surface of bone in front of that line; and it is *inserted* by a tendon into the upper half of the line on the femur, which extends from the linea aspera to the small trochanter. The muscle is twisted, so that the surfaces which are directed forwards and backwards near the pelvis, are turned inwards and outwards at its insertion. The pectineus lies between the psoas and the adductor longus, and the internal circumflex vessels pass between its outer border and the former muscle. One surface is in contact with the fascia lata, and the opposite touches the obturator muscle and nerve, and the adductor brevis.

Origin from pubes, inserted into femur.

Muscle is twisted.

Parts on the sides and surfaces

Adductor longus extends from pelvis to femur.

The ADDUCTOR LONGUS lies below the pectineus, and is triangular in form, with the apex at the pelvis and the base at the femur. It *arises* by a tendon from the spine of the os pubis, and from the body of the bone below that process, and is *inserted* into the linea aspera in the middle third of the shaft of the femur. This muscle is situate between the gracilis and pectineus, and forms part of the inner boundary of the triangular space containing the femoral vessels. Its anterior surface is covered near the femur by the femoral vessels and the sartorius; and the posterior rests on the other two adductors, on part of the obturator nerve, and on the deep femoral artery. Aponeurotic bands connect the tendon of the muscle at its insertion with those of the adductor magnus and vastus internus.

Its connections with muscles and vessels.

Dissect obturator nerve

Dissection.—On cutting through the pectineus near the pubes and throwing it down, the dissector will sometimes find the small accessory nerve of the obturator that turns beneath its outer border; if it is present, trace out its branches to the hip-joint and the obturator nerve. The adductor longus is then to be divided near its origin, and raised with care, so as not to destroy the branches of the obturator nerve beneath; its tendon is also to be detached from that of the adductor magnus to see the branches of the profunda artery. Now, the adductor brevis is laid bare, with a part of the obturator nerve crossing it to enter the plexus at the inner side of the thigh, and with a deeper part of the same nerve beneath it; the muscle should be separated from the subjacent adductor magnus where the lower nerve and an artery are seen to issue. In this last step of the dissection the student should seek a small articular branch of the obturator nerve, that descends on and in the fibres of the adductor magnus to the knee-joint.

and adductor brevis.

Articular nerve to knee-joint.

Accessory obturator nerve

The *accessory obturator* nerve* (Schmidt) is derived from the trunk of the obturator in the abdomen (p. 530.) and passes from that cavity over the brim of the pelvis. In the thigh this branch turns beneath the pectineus and joins the superficial part of the obturator nerve: at the same spot it supplies an offset to the under surface of the pectineus, and another to the hip-joint with the articular artery. When the nerve is small, one or more of these offsets is wanting.

is often absent.

Adductor brevis is thick at the origin

The ADDUCTOR BREVIS is thick and fleshy in the upper part, but thinner and tendinous at the lower extremity, at its attachment to the femur. The muscle *arises* below the adductor longus from the anterior aspect of the os pubis, between the attachments of the gracilis and obturator externus, and is *inserted* behind the pectineus into all the line leading from the linea aspera towards the small trochanter. In front of this muscle are the pectineus and the adductor longus; but it is gradually uncovered by the latter below, and the borders of the two are contiguous at their insertion into the femur: on this aspect, too, are the superficial part of

and wide at the insertion.

Parts in front,

* This small nerve is often absent; it was found only four or five times in nine or ten bodies that were examined by its discoverer. The name given to it by Schmidt refers to this irregularity, viz. nerv. ad obturatorem accessorius inconstans —*Commentarius de Nervis lumbalibus.*

the obturator nerve and the profunda artery. Behind the muscle is the adductor magnus, with the deep part of the obturator nerve. In contact with the upper border is the obturator externus, and the internal circumflex artery passes between the two. behind, and at upper border.

The OBTURATOR NERVE is a branch of the lumbar plexus (p. 530.), and supplies the adductor muscles of the thigh, with the hip and knee-joints. The nerve issues from the pelvis through the aperture in the upper part of the thyroid foramen, and divides therein into two parts, which are named superficial and deep, from their position with respect to the adductor brevis muscle. Obturator nerve is divided into two:

The *anterior* or *superficial* part of the nerve joins the plexus before referred to in the description of the internal cutaneous nerve, which is situate on the inner aspect of the thigh. To reach its destination the nerve is directed over the adductor brevis, but beneath the pectineus and the adductor longus. At the lower border of the last muscle it furnishes an offset to join in the interlacement with the internal cutaneous, and the branch of the saphenous nerve, but the remainder of the nerve is continued to the femoral artery, on which it is distributed. In addition to the branches before mentioned, the nerve receives the communicating twig from its accessory branch, and supplies the hip-joint, and some of the surrounding muscles. the superficial part joins plexus in the thigh, ends on femoral artery.

Branches. — Near the pelvis or in the aperture of exit, this division of the nerve sends outwards an *articular* twig to the hip-joint with the artery to the same part. *Muscular* branches are furnished to the adductor longus, the adductor brevis, and the gracilis. Branches are to hip-joint. Muscular to some adductors.

Unusual condition of the nerve. — In some bodies this superficial division of the nerve is of large size, and extends beyond the plexus in the middle of the thigh. In such instances the nerve joins freely in the plexus, and gives cutaneous offsets to the integument of the thigh, but is afterwards continued along the inner border of the sartorius to the inner side of the knee, where it perforates the fascia to end in the integument: it has, in fact, the same position and distribution as the inner branch of the internal cutaneous nerve (p. 624.), whose place it supplies. This part may be larger and extend to the inner side of the knee.

Deep part of the nerve

The *posterior* or *deep* part of the obturator nerve pierces the fibres of the external obturator muscle, and is continued beneath the adductor brevis to be distributed chiefly in the adductor magnus. Offsets are given from it to the contiguous muscles, and one to supply the knee-joint.

ends in adductor magnus,

and gives branch to knee-joint.

Branches. — *Muscular* branches enter the external obturator muscle as the nerve pierces it, and the others belong to the large adductor, but sometimes also to the short one. A slender *articular* branch enters the fibres of the adductor magnus towards its lower part, and is transmitted through them near the linea aspera to reach the popliteal artery, by which it is conducted to the back of the knee-joint: its termination will be found in the dissection of the popliteal space.

Dissect profunda.

Dissection. — To prepare the profunda artery and its branches, take from them the veins and the cellular membrane. Follow backwards then the internal circumflex artery above the upper border of the adductor brevis, and trace the perforating branches through the tendons of the adductors near the femur.

Profunda artery, origin, course,

and ending.

Parts around.

The PROFUNDA (deep femoral) is the chief muscular artery of the thigh, and arises from the femoral trunk about one inch and a half below Poupart's ligament (p. 615.). At its origin this vessel is placed on the outer side of the parent trunk, but it is then directed inwards beneath the femoral vessels to the inner side of the femur. Here it again changes the direction of its course, and descends parallel to the femoral artery, but deeper in position, to the lower third of the thigh, where it ends in a small branch that pierces the adductor magnus. Where the vessel lies in the triangular space of the thigh (near its origin) it rests on the iliacus muscle, but internal to the femur it is placed over the adductor brevis, and from that spot to its termination between the adductors longus and magnus.

Branches to muscles of the thigh join freely.

Its *branches* are numerous to the surrounding muscles and the bone, and maintain free anastomoses with other vessels supplied to the upper part of the thigh, as well as with those of the leg. It is through these communications that the blood finds its way to the lower part of the limb, when the tube of the chief artery is obliterated above the origin of the profunda. Some of the branches to the adductor

muscles are unnamed. The named branches are these: — external circumflex to the extensor muscles of the leg, internal circumflex round the inner side of the femur to the back of the thigh, and perforating arteries through the adductors to the same destination. The named branches are —

The *external circumflex* artery has been described in the dissection of the muscles of the front of the thigh (p. 623). external circumflex;

The *internal circumflex* branch arises from the inner and posterior part of the profunda, and turns backwards between the psoas and pectineus, above the border of the adductor brevis, along the course of the tendon of the external obturator muscle. Having reached the back of the thigh, it ends in two branches, which will be seen in the dissection of the buttock. It supplies the under-mentioned branches to the inner side of the thigh: — An *articular* artery enters the hip-joint through the notch in the acetabulum. At the border of the adductor brevis two *muscular* branches arise: one ascends to the obturator and the superficial adductor muscles, the other, which is larger, descends beneath the adductor brevis, and ends in this and the largest adductor. internal circumflex; ends on back of thigh, supplies hip-joint and muscles.

Peculiarities. — The origin of the internal circumflex is very variable. At one time it may be from the femoral artery above the profunda; at another from the epigastric, the external iliac, or the circumflex iliac artery. Origin variable.

The *perforating branches* are usually three in number, and pierce the tendons of the adductor muscles close to the linea aspera of the femur. The *first* is opposite the lower border of the pectineus, and perforates the short and long adductors. The *second* branch arises lower down, and passes through the same muscles as the preceding: from it a *nutritious* artery is supplied to the femur. The *third* artery springs from the deep femoral trunk below the adductor brevis, and is transmitted through the adductor magnus. The terminal branch of the profunda (fourth perforating) pierces the adductor magnus. These several branches supply the muscles of the back of the thigh, and anastomose above with branches of the internal iliac, and below with those of the popliteal artery. Three perforating branches; second gives nutritious artery, and the ending of profunda is a fourth.

The *profunda vein* results from the union of the different branches corresponding to those of the artery of the same name. It closely accompanies its companion artery, to which it is superficial, being between it and the femoral vessels. Sometimes the vein is suddenly enlarged at the upper part Profunda vein is some-

times joined by popliteal. by the union of a large trunk that is directed upwards from the popliteal vein, behind the adductor magnus, and then pierces this muscle.

Cut through adductor brevis. *Dissection.*—To bring into view the remaining muscles, viz. the adductor magnus, the obturator externus, and the insertion of the psoas and iliacus, the adductor brevis is to be cut through, and the cellular membrane to be removed from each. After the adductor magnus has been learnt, it will be needful to detach a few of its upper fibres to examine the obturator externus.

Adductor magnus; origin is narrow; The ADDUCTOR MAGNUS is triangular in form, and is fixed by its apex to the pelvis, and by its base to the femur in nearly all the length of the bone. Its *origin* is from the descending ramus of the os pubis, and from the ascending ramus and tuberosity of the ischium, and its fibres are directed, with different degrees of obliquity, to their attachment to the femur. fibres diverge to their insertion, Thus the upper fibres, from the rami of the pubis and ischium, are horizontal above, but become more and more oblique below, and are *inserted* into the linea quadrata and the line continued from the great trochanter to the linea aspera, some being horizontal, also into all the linea aspera, and into a small part of the line leading from that crest of bone to the inner condyle of the femur. Whilst the remaining fibres others vertical, from the tuberosity of the ischium, which are vertical in direction, end about the lower third of the thigh in a tendon, which is inserted into the inner condyle of the femur, and is connected by a fibrous expansion to the line leading upwards from that point of the bone to the linea aspera.

and form two different parts. The muscle consists of the two parts above described, which differ in their characters. The upper one is thin and muscular, and forms a septum between the other adductors and the muscles on the back of the thigh; but the inner or lower piece is partly fleshy and partly tendinous, and consists of thick coarse fibres. Connections of the anterior On the anterior surface of the adductor magnus are the other two adductor muscles, with the pectineus, and the obturator nerve and profunda artery. and posterior surface; The posterior surface is in connection with the hamstring muscles and the great sciatic nerve. upper and In contact with the upper border are the obturator externus and the quadratus femoris, with the internal circumflex artery; and

along the lower or inner border are the gracilis and the sartorius. At its attachment to the femur the muscle is closely united with the other adductors, particularly the adductor longus, and is there pierced by apertures for the femoral and perforating arteries. lower borders; and its insertion.

The *opening* in the adductor for the transmission of the femoral vessels into the popliteal space is tendinous on the anterior aspect, but fleshy at the posterior, and is situate at the junction of the middle with the lower third of the thigh. It is larger than is necessary for the passage of the vessels, and is bounded on the outside by the vastus internus, but on the inside by the tendon of the adductor magnus, with some fibres added from that of the long adductor. Opening for the vessels; boundaries.

The PSOAS and ILIACUS arise separately in the abdomen (p. 524.), but are united in the part that is contained in the thigh. The conjoined crural portion of these muscles is seen to come beneath Poupart's ligament, and to descend to be *inserted* by a tendon into the back of the small trochanter of the femur, as well as by fleshy fibres into a special surface of the bone below that eminence. Beneath the ligament the muscles occupy the interval between the ilio-pectineal eminence and the anterior superior spinous process of the ilium. On the front of the psoas is the femoral artery, and between the two lies the anterior crural nerve; whilst the fleshy mass covers the capsule of the hip-joint and an intervening bursa. The pectineus and the internal circumflex artery are contiguous to the inner border, and the sartorius and vastus internus to the outer edge of the muscles. Psoas and iliacus in the thigh. Insertion into femur. Parts around.

The OBTURATOR EXTERNUS is of a conical form, with the base of the cone at the pelvis and the apex at the femur. The fibres of the muscle take *origin* from the inner half of the obturator membrane, at the outer aspect, and from the bone bounding internally the foramen of the same name: from that spot they are directed obliquely outwards and backwards to be *inserted* by a tendon into the pit at the root of the great trochanter. This muscle is concealed by the pectineus, adductor brevis, and adductor magnus, and is pierced by part of the obturator nerve; it covers the obturator membrane and artery. As it turns back it is in con- Obturator externus; origin, insertion. The adductors cover it,

and it touches hip-joint. tact with the inner and the lower part of the hip-joint. The insertion of the muscle will be seen in the dissection of the buttock.

Detach obturator. *Dissection.* — By detaching the obturator muscle in part from the pelvis, the branches of the artery and nerve of the same name will be seen amongst its fibres.

Obturator artery The *obturator artery* is a branch of the internal iliac (p. 554.), and enters the thigh through the upper part of the thyroid foramen; whilst in its aperture the artery divides

divides into two, into two parts that inosculate and form a circle around the obturator membrane beneath the muscle.

upper and lower branch; The *upper* branch extends along the inner half of the membrane, and anastomoses inferiorly with the other. The *lower* branch perforates the membrane beneath the upper one, and turns down along the outer part to form a circle near the circumference by

this gives articular twig. uniting with the preceding branch. This supplies an *articular* twig to the hip-joint. Offsets of the obturator artery are furnished to the muscle that covers it, and some small twigs extend even to the upper part of the adductors.

Branches of the nerve. The *branches* of the *nerve* come from the deep division of the obturator trunk, and perforate the membrane with the lower branch of the artery. They are distributed to the substance of the muscle.

Section II.

THE BUTTOCK, OR THE GLUTEAL REGION.

Position of the body. *Position.* — During the dissection of the back of the thigh the body is placed with the face down, and the pelvis is raised by blocks until the lower limbs hang almost vertically over the end of the dissecting table.

Directions. Now the body is turned, the student can better recognise the points of bone that mark posteriorly the limit between the thigh and the abdomen (p. 597.). Both this section and the following one are to be gone through in the time appointed for the body to lie in its present position.

Dissection. — The integument is to be raised from the buttock by means of these two incisions: — One is to be made along the crest of the ilium, and to be continued in the middle line of the sacrum to the tip of the coccyx; another is to be begun where the first terminates, and to be carried outwards on the thigh till about six inches below the great trochanter. The flap of skin thus marked out above and below is to be thrown downwards. Take up the skin.

Several of the cutaneous nerves of this region will be found in the fat or beneath it, along the line of the crest of the ilium. Beginning in front, the student will first meet with branches of the external cutaneous rather below the crest. Crossing the crest, near its front, is an offset of the last dorsal nerve, and, farther back, another from the ilio-hypogastric nerve; whilst in a line with the outer border of the erector spinæ are two or three branches of the lumbar nerves. By the side of the sacrum and coccyx are two or three offsets of the sacral nerves. Cutaneous nerves from above where found.

The remaining cutaneous nerves are derived from the small sciatic, and will be found beneath the fat along the line of the lower incision, where they come from underneath the gluteus maximus; some turn upwards over that muscle, and others are directed down to the thigh. Other nerves of small sciatic.

Cutaneous Nerves. — The nerves distributed in the integument of the buttock are small but numerous, and are derived from the spinal nerves (posterior divisions), from the branches of the lumbar and sacral plexuses, and from the last dorsal nerve. Sources of the cutaneous nerves.

Branches of the spinal nerves. — The *branches* of the posterior divisions of the *lumbar nerves* are two or three in number, and cross the crest of the ilium at the attachment of the erector spinæ. They ramify in the integument covering the gluteus muscle, and some branches may be traced nearly to the trochanter major. The *branches* of the *sacral nerves* perforate the gluteus maximus near its origin, and are then directed outwards for a short distance in the integument over it. These offsets are usually three in number; one, the largest, is opposite the lower end of the sacrum, another is near the crest of the ilium, and the third is between the other two. From lumbar and sacral nerves.

Nerves from the lumbar plexus. — Parts of two nerves from the lumbar plexus, viz. ilio-hypogastric and external cutaneous, are spent in the integument of this region. The *iliac branch* of the ilio-hypogastric nerve crosses the crest of the ilium in front of the From lumbar plexus, through ilio-hypogastric.

branches from the lumbar nerves, and extends a short distance below the crest: this branch is very variable in size, or it may be wanting. *Offsets* of the *external cutaneous* nerve of the thigh bend backwards to the integument above the great trochanter, and cross the divisions of the branch of the last dorsal nerve.

External cutaneous.

From sacral plexus, through small sciatic.

Nerves from the sacral plexus. — Only one nerve of the plexus, the small sciatic, sends here superficial branches. The cutaneous offsets of this nerve appear along the lower border of the gluteus maximus; two or three ascend round the edge of the muscle, and are lost in the integument over its lower part; but the remaining branches descend to the thigh, and will be afterwards noticed on it.

From last dorsal nerve.

The *last dorsal nerve* supplies the buttock by means of its lateral cutaneous branch (p. 417.). This perforates the muscles of the abdomen, and crosses the anterior part of the crest of the ilium to be distributed over the fore part of the gluteal region as low as the great trochanter.

Clean gluteus maximus.

Dissection. — In the dissection of this region it is customary to disregard the deep fascia, which is here unimportant, in order that the great gluteal muscle, which is the most difficult in the body to make clean, may be well displayed. Supposing the student desirous to lay bare the muscle at once, let him turn aside the cutaneous nerves, and draw away and rotate inwards the limb to make tense the muscular fibres. Having cut through the fat and fascia down to the muscle, let him carry the scalpel along one fibre at a time, in the direction of a line from the sacrum to the femur, until all the coarse fasciculi are cleaned. If it is the right limb, the dissection should be begun at the upper border; but if the left, at the lower margin of the muscle.

Mode of proceeding.

Fascia of the buttock is thin and unimportant.

The thin *fascia* of the buttock is a prolongation of that enveloping the thigh, and is fixed to the crest of the ilium and to the sacrum and coccyx. It is much thicker in front of the gluteus maximus than on it, and gives attachment at that spot to the gluteus medius which it covers. At the edge of the gluteus maximus the fascia is slit to encase this muscle.

Gluteus maximus.

The GLUTEUS MAXIMUS is the most superficial muscle of the buttock, and reaches from the pelvis to the upper part of the femur. Its highest and lowest fibres are attached to bone, but the central ones only to an aponeurosis. Thus the muscle *arises* above from the posterior fifth of the crest of

Origin above from pelvis;

the ilium (its outer lip), and from a special impression on the bone below; inferiorly from the back of the last piece of the sacrum, and from the coccyx and the great sacro-sciatic ligament; and between the iliac and sacral attachments from the tendon of the erector spinæ muscle. From this origin the fibres are directed outwards to their *insertion*: two-thirds end in the fascia lata of the outer part of the thigh, and the remainder are fixed into the femur in the lower part of the line leading from the linea aspera to the great trochanter. The gluteus forms the prominence of the buttock, and resembles the deltoid in situation and in coarseness of texture. Its cutaneous surface is covered by the common investing fasciæ of the limb, and by the superficial nerves; the parts in contact with the under surface will be seen when the muscle is cut through. The upper border overlays the gluteus medius; and the lower border, which is longer and thicker than the upper, assists to form the outer boundary of the perinæal space. Beneath the lower border the hamstring muscles and the sciatic vessels and nerves are placed.

Inserted below into the femur.

Connections of the surfaces

and borders.

Dissection. — The gluteus maximus is to be cut across near the pelvis, but external to the sacral nerves perforating it, and without injuring the subjacent sacro-sciatic ligament, when the lower fibres are divided. The depth of the muscle will be ascertained by the fascia beneath it, and by some vessels. When this intermuscular layer is arrived at, the outer part of the gluteus is to be thrown towards its insertion, and the sciatic artery and nerve are to be detached from the under surface, though the branches that enter the muscular substance must be cut.

Divide the gluteus maximus.

Take away now the loose fat from the hollow between the pelvis and the trochanter, without injuring the vessels and nerves; clean the several muscles of this region, and let the fibres of each be made tense at the time by rotating the femur. In removing the fat from the tuberosity of the ischium and from the great trochanter, observe the bursa on each prominence of bone. The vessels, nerves, and muscles to be made out in this region, are noticed below in the enumeration of the parts beneath the gluteus.

Clean parts beneath.

Lastly, the origin of the muscle is to be removed; and the sacral nerves to be dissected out of it, and followed to the surface of the great sacro-sciatic ligament, where they are united and concealed by some aponeurotic fibres.

Dissect out sacral nerves.

Parts covered by gluteus at its origin and insertion,

Parts beneath the gluteus. — At its origin the gluteus maximus rests on the pelvis, and conceals part of the ilium, sacrum, and coccyx, the tuberosity of the ischium, and the origin of the hamstring muscles, as well as the great sacro-sciatic ligament. At its insertion it covers the upper end of the femur with the great trochanter, and the origin of the vastus externus. Between the muscle and each prominence of bone (tuberosity and trochanter) is a large, loose synovial membrane, and the outer one extends over the upper part of the vastus externus. In the hollow between the pelvis and the femur the muscle conceals the undermentioned parts, which are given here in their order from above downwards. First is a part of the gluteus medius, and below it is the pyriformis, with the superficial branch of the gluteal artery between them. Coming from beneath the pyriformis are the sciatic vessels and the sciatic nerves (large and small), which descend to the back of the thigh between the great trochanter and the tuberosity of the ischium; together with the pudic vessels and nerve, and the nerve to the obturator internus muscle, which are directed inwards through the small sacro-sciatic notch. Still lower down is the tendon of the obturator internus muscle, with a fleshy fasciculus (gemellus) above and below it. Next follow the thin quadratus femoris muscle, and the upper part of the adductor magnus; at the upper border of the quadratus is the tendon of the obturator externus, and at the lower border, between it and the adductor, is one of the terminal branches of the internal circumflex artery.

and by the intervening part of the muscle.

The external branches of sacral nerves are united beneath gluteus.

Sacral nerves. — The external branches of the posterior divisions of the three first sacral nerves, after passing outwards beneath the multifidus spinæ (p. 378.), are joined on the surface of the great sacro-sciatic ligament by loops. Two or three cutaneous offsets are derived from this intercommunication, and pierce the fibres of the gluteus maximus to be distributed on the surface (p. 635.).

Gluteus medius

arises from os ilii,

The GLUTEUS MEDIUS is triangular in form, and has its base at the innominate bone, and its apex at the femur. It *arises* from the outer surface of the os ilii, between the crest and the superior curved line, except where the gluteus

maximus is attached, and from the strong fascia covering its anterior part. The fibres of origin converge to a tendon which is *inserted* into an impression on the outer surface of the great trochanter, but between the tendon and the bone is a small bursa. The superficial surface is concealed in part by the gluteus maximus, and the deep is in contact with the gluteus minimus, and with the gluteal vessels and nerve. The anterior border is joined with the gluteus minimus, and the posterior is contiguous to the pyriformis, only the gluteal artery intervening.

and inserted into trochanter.

Connections.

Dissection.—When the gluteus medius is detached from the ilium, and partly separated from the gluteus minimus beneath, the gluteal vessels and nerve will come into view. The two chief branches of the artery and nerve, one being near the crest of the ilium, and the other lower down, are to be traced through the fleshy fibres as the reflection of the gluteus is proceeded with, and the nerve is to be followed on to the tensor vaginæ femoris muscle. A branch of the artery to the gluteus maximus has necessarily been cut.

Detach gluteus medius to see gluteal vessels and nerve.

The *gluteal artery* is the largest branch of the internal iliac (p. 554.), and issues from the pelvis above the pyriformis muscle. On the dorsum of the ilium it ends in branches that supply the gluteal muscles and the bone, and anastomose with the other branches to this spot. Its named branches are superficial and deep:—

Gluteal artery is divided into two:

a. The *superficial* branch sends inwards a few twigs over the sacrum, and ends in the gluteus maximus, which it penetrates on the under surface.

superficial and

b. The *deep branch*, which is the continuation of the artery, is subdivided into two. One (superior) courses along the origin of the gluteus minimus with a branch of the nerve to the front of the crest of the ilium, where it anastomoses with the ascending branches of the external circumflex artery. The other division (inferior) is directed forwards over the middle of the smallest gluteal muscle towards the lower anterior spine of the ilium and the great trochanter, and communicates also with the external circumflex branches; a few offsets from it pierce the muscle to supply the hip-joint.

deep branch.

This has an upper and a lower piece.

Vein.—The companion vein of this artery enters the pelvis, and ends in the internal iliac vein.

Gluteal vein.

Superior gluteal nerve is muscular.

The *superior gluteal nerve* is a branch of the lumbo-sacral cord before this ends in the sacral plexus (p. 560.). It accompanies the artery, and divides, like it, into two branches that supply the two smallest gluteal muscles; but the lower branch may be traced into the tensor vaginæ femoris.

Gluteus minimus. Attachments. Is next the bone, and is joined with preceding.

The GLUTEUS MINIMUS is likewise conical in shape, and *arises* from the dorsum of the ilium between the curved lines: the fibres are collected on a tendon which is *inserted* into the fore part of the great trochanter, where it is united with that of the gluteus medius. One surface is in contact with the gluteus medius, and the gluteal vessels and nerve; the other with the hip-joint and the bone, and with the outer head of the rectus femoris muscle. The anterior border is blended with the other gluteus, and the posterior touches the pyriformis muscle.

Divide smallest gluteus.

Dissection. — Divide the smallest gluteal muscle near the innominate bone, and define the tendinous part of the rectus femoris which is close above the hip-joint. At the same time the deep vessels to the articulation may be observed and followed.

Outer head of the rectus; where attached.

The *outer head* of the *rectus femoris* is a slip of tendon that reaches outwards, almost horizontally, above the margin of the acetabulum. In front it joins the other tendinous piece of the rectus that is attached to the anterior inferior spine of the ilium, and below it is connected by fibres with the capsule of the hip-joint.

Origin in the pelvis. Insertion into the femur; lies in sacro-sciatic notch. Position to other parts.

The PYRIFORMIS *arises* in the pelvis from the front of the sacrum (p. 587.), and comes from that cavity through the great sacro-sciatic notch. Outside the pelvis it ends in a tendon, that is *inserted* into the upper border of the great trochanter behind the gluteus minimus, with which it is frequently united. As the muscle passes through the sacro-sciatic notch it divides that space into two parts: the upper of these gives passage to the gluteal vesssels and nerve, and the lower to the sciatic and pudic vessels and nerve. Its upper border is contiguous to the gluteus medius, and its lower edge to the gemellus superior. Like the other rotator

muscles in this situation it is covered by the gluteus maximus, and rests on the hip-joint.

Dissection. — The pyriformis may be cut across and raised towards the sacrum, to allow the dissector to trace upwards the sciatic and pudic vessels, and the nerves of the same name to the lower part of the sacral plexus. Some small offsets to the gemellus superior and to the hip-joint are to be sought at the lower part of the plexus. A branch to the inferior gemellus and the quadratus will be found by raising the trunk of the great sciatic nerve; but as it passes beneath those muscles it will be followed to its termination after their examination. Dissect out the vessels and the nerves.

Sciatic and Pudic Vessels. — The vessels on the back of the pelvis, below the pyriformis muscle, are branches of the internal iliac, like the gluteal artery (p. 552.). The vessels here come from the iliac.

The *sciatic artery*, after escaping from the pelvis below the pyriformis, descends over the gemelli and obturator muscles, in the interval between the trochanter and the tuberosity of the ischium, as far as the quadratus femoris; here the artery ends in branches that supply the surrounding parts, and anastomose with the internal circumflex branch of the profunda artery. In this course it furnishes *muscular* offsets to the great gluteus and the rotator muscles, and some *articular* branches to the hip-joint: it supplies also the following named branches: — Sciatic artery; course and ending. Branches to joint and muscles.

a. The *coccygeal branch* arising close to the pelvis perforates the great sacro-sciatic ligament and the gluteus maximus, and ramifies in this muscle and on the back of the sacrum. Coccygeal branch.

b. The *branch* to the great *sciatic nerve* (comes nervi ischiadici) is very slender, and enters the substance of the nerve near the pelvis; it extends in the nerve along the thigh, supplying offsets to it. Branch to the sciatic nerve.

c. The *branch to the quadratus* passes with the nerve of the same name beneath the gemelli and obturator internus, and gives branches to the hip-joint and the inferior gemellus before it ends in its muscle. Branch to the quadratus.

The *pudic artery* is less than the sciatic, and internal to it. Only a small part of the artery is seen on the back of the pelvis, for, after winding over the spine of the ischium, it enters the perinæal space through the small sacro-sciatic notch to be there distributed (p. 407.). It supplies a small Pudic artery crosses spine of the ischium.

branch over the back of the sacrum, which anastomoses with the gluteal and sciatic vessels, and another twig accompanies the nerve to the obturator internus muscle.

Veins.

The *veins* with the sciatic and pudic arteries receive contributing twigs corresponding to the branches of those arteries, and open into the internal iliac vein.

Nerves come from sacral plexus.

SCIATIC AND PUDIC NERVES.—The nerves appearing at the back of the pelvis, below the pyriformis, are branches of the sacral plexus to the lower limb, or to parts exterior to the pelvic cavity (p. 559.). Some small muscular branches are present at the same spot.

Small sciatic nerve is chiefly a cutaneous nerve;

The *small sciatic nerve* springs from the lower part of the sacral plexus generally by two parts, that sometimes remain separate, and may be considered a cutaneous nerve of the back of the thigh, for it supplies only the gluteus maximus muscle. The nerve takes the course of the sciatic artery as far as the lower border of the great gluteus, where it gives many cutaneous branches upwards and downwards: much diminished in size at that spot, the nerve is continued along the back of the thigh beneath the fascia, and ends in the integument of the posterior part of the leg. The branches that are distributed above the region of the posterior part of the thigh are muscular and cutaneous.

ends in the leg;

gives branches to gluteus maximus.

a. The *muscular branches* (inferior gluteal) enter the under surface of the gluteus maximus near its lower border. A separate offset of the sacral plexus is usually furnished to the upper part of the muscle.

Cutaneous nerves over the buttock and to the thigh;

b. The *cutaneous branches* are directed either upwards or downwards at the border of the gluteus. The *upper* set are distributed in the superficial fascia over the lower part of the muscle, and the *lower* set supply the integument of the inner side of the thigh at the posterior aspect. One branch of the last set, which is larger than the others, is distributed to the genital organs, and is named *inferior pudendal* (p. 402.); in its course to the perinæum it turns below the tuberosity of the ischium, and perforates the fascia lata only when it has nearly reached the perinæal space. Sometimes the inferior pudendal is a distinct branch of the plexus.

one of the last set named pudendal.

Great sciatic nerve;

The *great sciatic* is the largest nerve in the body, and is the source of all the muscular and most of the cutaneous

branches beyond the knee, as well as of the muscular branches of the back of the thigh. At its origin from the sacral plexus it appears to be a prolongation of this interlacement of nerves. After leaving the pelvis, it is directed through the region of the buttock to the posterior part of the thigh, where it divides into two large trunks (internal and external popliteal), that are continued to the leg. In the part of its course now dissected, viz., to the lower border of the gluteus maximus, it lies on the external rotator muscles below the pyriformis, in the hollow between the tuberosity of the ischium and the great trochanter, where it is beneath the gluteus. Oftentimes the nerve is divided into two large trunks at its origin, and one pierces the fibres of the pyriformis muscle. Commonly it does not supply any branch to the buttock, but it may give origin to a few filaments to the hip-joint.

outline of, and ending; course in the buttock. No branch in this part.

The *pudic nerve* winds over the spine of the ischium with its companion artery and the nerve to the obturator internus muscle, and is distributed with the vessel to the perinæum and the genital organs (p. 408.). No branch is supplied by it to the buttock.

Pudic nerve.

The remaining muscular and articular branches are also derived from the lower part of the sacral plexus.

Other branches of the plexus.

Some *nerves* to the *hip-joint* perforate the back of the capsular ligament, and supply the articulation.

Nerves to the hip;

A *nerve* to the *superior gemellus* is a very small twig, that arises separately from the lower part of the plexus.

to superior gemellus.

A *nerve* to the *inferior gemellus* and the *quadratus* is a slender branch, that passes with a companion artery beneath the gemelli and the obturator internus, and ends in the two muscles from which it receives its designation. This nerve will be more fully seen in a subsequent dissection, when *articular* filaments from it to the hip-joint may be recognised.

Nerve to gemellus and quadratus.

Dissection.—To see the remaining small rotator muscles, hook aside the great sciatic nerve, and take away the branches of the sciatic artery if it may be necessary. In cleaning these muscles keep the limb rotated inwards. The gemelli are to be turned aside from the tendon of the obturator internus.

Clean rotator muscles.

The SUPERIOR GEMELLUS is the highest of the two muscular slips along the tendon of the obturator muscle. In-

Superior gemellus

is often absent.

ternally it is attached to the spine of the ischium, and externally it is inserted with the obturator into the great trochanter. Oftentimes this muscle is absent.

Inferior gemellus inserted with obturator.

The INFERIOR GEMELLUS is larger and more constant than its fellow. Its *origin* is connected with the upper and back part of the tuberosity of the ischium, and its *insertion* is the same as that of the obturator tendon. This muscle is placed between the obturator internus and quadratus muscles, but near the femur the tendon of the obturator externus comes into contact with its lower border.

Obturator internus has part in and part outside pelvis; latter part lies over hip joint; its tendon is divided on the edge of the pelvis.

The OBTURATOR INTERNUS arises inside the pelvis, and passes to the exterior through the small sacro-sciatic notch (p. 587.). The muscle is then directed outwards over the articulation of the hip, and is *inserted* by a tendon with the gemelli into the upper border of the great trochanter, in front of the pyriformis, as well as into the inner surface of that process above the pit at the root. Outside the pelvis the obturator is mostly tendinous, and is embraced by the gemelli muscles; crossing the muscle are the large and small sciatic nerves and the sciatic vessels, and covering the whole is the gluteus maximus. On cutting through the tendon, and raising the inner end, it will be found divided into four or five pieces as it turns over the margin of the pelvis; at this spot the pelvis is marked by ridges of cartilage that correspond to the intervals between the tendons, and the whole is lubricated by a synovial membrane.

Quadratus femoris; origin; insertion; parts above and beneath it, and at

The QUADRATUS FEMORIS is of the form expressed by its name, and is situate between the inferior gemellus and the adductor magnus. Internally it *arises* from a ridge on the outer part of the tuberosity of the ischium, close to the origin of the adductor magnus, and externally it is *inserted* into the linea quadrata of the upper end of the femur, above the attachment of the great adductor to the same line. By one surface it is in contact with the sciatic vessels and nerves and the gluteus; and by the other surface it rests on the obturator externus, the internal circumflex artery, and the small branches of both the nerve and artery that supply it. Between its lower border and the adductor magnus

one of the terminal branches of the internal circumflex artery issues. lower border.

Dissection.—The quadratus and the gemelli muscles may now be cut across to dissect the obturator externus, the ending of the internal circumflex artery, and the small nerve and artery to the same muscles. Dissect circumflex artery.

The *internal circumflex* branch of the profunda artery (p. 631.) divides finally into two parts. One ascends beneath the quadratus, in this position of the body, to the pit of the trochanter, where it anastomoses with the sciatic artery, and supplies the bone. The other passes between the quadratus and adductor magnus to the hamstring muscles, and communicates also with the sciatic artery. Internal circumflex artery ends in two branches.

The OBTURATOR EXTERNUS has been dissected at its origin in the front of the thigh (p. 633.). In the part of its course now laid bare, the muscle lies at first below the hip-joint, but farther on it ascends from that position to be *inserted* into the pit at the root of the great trochanter. On the back of the pelvis the obturator externus is covered by the quadratus, except near the femur, where the upper border is in contact with the inferior gemellus. Obturator externus is inserted into the trochanter. Connections with quadratus.

The SACRO-SCIATIC LIGAMENTS pass from the innominate bone to the sacrum and coccyx; they are two in number, and are named large and small. Sacro-sciatic ligaments.

The *large* or *posterior* ligament is attached internally to the lower posterior spine of the ilium, and to the side of the sacrum and coccyx; and externally to the inner margin of the tuberosity of the ischium. It is wide next the sacrum, but contracted towards its middle, and is expanded again at the ischial tuberosity, where it sends upwards a prolongation along the ramus of that bone. On the cutaneous surface are the branches of the sacral nerves, and the gluteus maximus conceals and takes origin from it. Attachments of the large one. Form; gives a prolongation

The *small ligament* will be seen on dividing the other near the tuberosity of the ischium. At the sacrum and coccyx it is united with the large ligamentous band, but at the opposite end it is inserted into the spine of the ischium. Small ligament; attachments;

It is less strong than the superficial ligament by which it is concealed, and rests on the coccygeus muscle.

they give rise to two notches: These ligaments convert the large sacro-sciatic notch of the dried pelvis into two apertures or foramina by their attachments to the bones. Between the insertion of the two into the innominate bone (the spine and tuberosity) is the small, with contents, small sacro-sciatic foramen, which contains the internal obturator muscle, the pudic vessels and nerve, and the nerve to the same muscle. Whilst above the smaller ligament is large, and parts passing through it. the large sacro-sciatic foramen, which gives passage to the pyriformis muscle, and the several vessels and nerves above and below it, which have been already examined, viz. the gluteal vessels, and the superior gluteal nerve above it; and the sciatic and pudic vessels and nerves, with some muscular branches of the plexus below it.

Section III.

THE BACK OF THE THIGH.

Directions. The ham or the popliteal space may be taken next after the buttock, in order that its size and boundaries may be less disturbed than they would be after the examination of the muscles at the back of the thigh. When this space has been learnt the student will return to the dissection of the thigh.

Position. *Position.* — The limb is to remain in the same position as in the dissection of the buttock.

Take the skin from over the ham. *Dissection.* — To remove the skin from the part of the limb to be examined, make an incision behind the knee-joint, beginning it about six inches above the knee, and ending it four inches below the joint. At each extremity of this longitudinal cut, let a transverse incision be made, so as to allow two flaps of skin to be raised, the one outwards and the other inwards.

Seek the cutaneous nerves. In the superficial fascia some small cutaneous nerves may be found, viz. one or two twigs in the middle line of the limb from the small sciatic nerve beneath the fascia, and some offsets of the internal cutaneous towards the inner part of the limb.

After the fat is removed, the special *fascia* of the limb (fascia lata) will be brought into view. Where it covers the popliteal space it is strengthened by transverse fibres, particularly on the outer side, and at each side it is connected with the tendons bounding that interval. Sometimes the short saphenous vein is seen to perforate it opposite the knee, but usually at a spot lower down. Fascia of the limb over the ham.

Dissection.—The fascia is now to be removed over the ham, without injuring the small sciatic nerve and the short saphenous vein, which are beneath it. A large quantity of fat is next to be taken out of the ham, and the several vessels and nerves to be made out. After the space has been cleaned, the sartorius and gracilis are to be replaced on the inner side. Remove fascia, and take the fat from the ham.

In the middle line the student will first come upon the large internal popliteal nerve, and nearer the outer side on the external popliteal; both give branches, and these will be recognised more certainly by tracing them down the trunk of the nerve, than by proceeding in the opposite direction. In fat bodies the small nerves to the knee-joint are difficult to find. Under cover of the outer boundary, and deep in the space, is an articular nerve (external), which sometimes arises from the great sciatic. Seek the nerves in the space,

In the bottom of the space are the popliteal vessels, and the vein is more superficial than the artery. The student is to seek an articular branch (superior) on each side close above the condyle of the femur. Numerous other branches of the vessels to the muscles around, especially below, are to be cleaned. On the upper part of the artery the branch of nerve to the knee-joint from the obturator may be found. and clean the vessels. With obturator nerve.

The POPLITEAL SPACE, or the ham, is a hollow behind the knee-joint, which contains the large vessels of the limb, and allows of the free flexion of the joint. When dissected, this interval, which has the form of a lozenge, extends upwards for one-third of the femur, and downwards for one-sixth of the tibia; but in the natural condition of the parts the sides are approximated by the fascia of the limb, and the space is limited almost to the region of the joint. The ham; situation and extent.

The ham is situate between the attachments of the muscles to the condyles of the femur, and the lateral boundaries are therefore formed in part by the muscles of the thigh (hamstrings), and in part by those of the leg. Thus, on the Boundaries;

outer side, is the biceps muscle, as far as the joint, and the plantaris and the external head of the gastrocnemius are below it; but on the inner side, as low as the articulation, are the semimembranosus and semitendinosus muscles, with the gracilis and sartorius between these and the femur; and beyond that spot is the inner head of the gastrocnemius. The upper point of the space is limited by the apposition of the inner and outer hamstring muscles, in the middle line of the thigh; and the lower angle by the union of the heads of the gastrocnemius. Stretched across this cavity is the fascia lata; and, forming the deep boundary, or the floor, are the following parts, — the lower end of the posterior surface of the femur included between the lines to the condyles, the posterior ligament of the joint, and the popliteus muscle, with the upper end of the tibia.

outer and inner. Limit above and below. Deep boundary.

The popliteal space is widest opposite the knee-joint, where the muscles are most drawn to the sides, and is deepest above the articular end of the femur. In it are contained, besides the fat, the popliteal vessels and their branches, with lymphatics; the popliteal divisions of the great sciatic nerve, and some of their branches; and the ending of the external saphenous vein. The small sciatic nerve lies over the space, and the branch of the obturator is on the artery in the bottom of the cavity.

Greatest width and depth; contents.

The POPLITEAL ARTERY is the continuation of the femoral, and reaches from the opening in the adductor magnus to the lower border of the popliteus muscle, where it bifurcates into the anterior and posterior tibial vessels. In a part of its extent this trunk lies in the ham, and is uncovered by muscle; but, inferiorly, it is beneath the gastrocnemius, and beyond the limits of the popliteal space as above defined: the description of the artery may, therefore, be divided into two parts, corresponding with the difference in its connections.

Popliteal artery; extent; part is in the ham, and part beyond.

The part of the vessel in the ham is inclined obliquely from the inner side of the limb to the interval between the condyles of the femur, and then along the middle of the space over the knee-joint. In this course it is overlaid at first by the belly of the semimembranosus muscle, but thence onwards to the gastrocnemius it is covered only by the fat,

The part in the space; course and connections.

the fascia lata, and the integuments; behind it is the lower part of the posterior surface of the femur, together with the posterior ligament of the knee-joint. In contact with the vessel, and somewhat on its outer side, lies the popliteal vein, so that, on looking into the cavity, the arterial trunk is almost covered by it; but, lower down, in the interval between the heads of the gastrocnemius, the vein and its branches altogether conceal the artery. More superficial than the large vessels, and slightly external to them in position, is placed the internal popliteal nerve, which, however, like the vein, lies over the artery between the heads of the gastrocnemius.

Position of vein and of the nerve.

Dissection.—To see the artery beneath the gastrocnemius cut through the inner head of the muscle, and, raising it, take away the cellular tissue from the vessels and nerves. The lower articular vessels and nerves are now brought into view; the inner artery is below the head of the tibia, and the outer higher up between the tibia and fibula, with a vein and nerve.

Cut the head of the gastrocnemius.

Whilst the artery is beneath the gastrocnemius it sinks deeply into the limb, and is crossed by a small muscle, the plantaris; at this spot it rests on the popliteus muscle. Both the vein and the nerve (internal popliteal) change their position to the artery, and gradually cross over it, so as to lie on its inner side at the lower border of the popliteus.

Connections of the artery farther on. Position of vein and nerve.

Branches are furnished by the artery to the surrounding muscles, and to the articulation; those that enter the joint are five in number, and are called articular, viz. two superior, inner and outer; two inferior, also inner and outer; and a central or azygos branch.

Branches.

The *muscular branches* have not received separate names, with the exception of those to the gastrocnemius and soleus, which are called *sural* arteries. One superficial or cutaneous branch accompanies the short saphenous nerve above the muscles of the leg.

Muscular branches and cutaneous.

The *superior articular* arteries arise from the popliteal trunk, one from the inner and one from the outer side, above the condyles of the femur; they are directed almost transversely beneath the hamstring muscles, and turn round the bone to the front of the joint.

Branches to the joint are five; two superior,

external — The *external* one perforates the intermuscular septum, and divides in the substance of the vastus externus: some of the branches end in that muscle, and anastomose with the external circumflex; others descend to the joint; and one offset forms an arch across the bone with the anastomotic artery.

and internal. — The *internal* artery, oftentimes very small, winds beneath the tendon of the adductor magnus, and ends in the vastus internus in branches that supply it and the knee-joint, and communicate with the anastomotic artery.

Two inferior; — The *inferior articular* branches lie beneath the gastrocnemius, but are not on the same level on the two sides of the limb, for the inner one descends below the head of the tibia, whilst the outer one is placed between the tibia and the fibula. Each lies beneath the lateral ligament of its own side.

also external — The *external* branch supplies the outer side of the knee-joint, and anastomoses with the other vessels on the articulation, and with the recurrent branch of the anterior tibial artery: it sends an offset beneath the ligament of the patella to join a similar twig from the corresponding artery of the opposite side.

and internal, — The *internal* artery turns upwards to the joint at the anterior border of the internal lateral ligament, and, after taking its share in the free anastomoses over this part, ends in offsets for the joint and the head of the tibia.

and one central artery. — The *azygos* branch enters the back of the joint through the posterior ligament, and is distributed to the ligamentous structures and the synovial membrane of the interior.

Popliteal vein. — The POPLITEAL VEIN originates in the union of the venæ comites of the anterior and posterior tibial vessels, and has the same extent and connections as the artery it accompanies. Position to the artery. — At the lower border of the popliteus muscle the vein is internal to the arterial trunk; between the heads of the gastrocnemius it is superficial to that vessel; and thence to the opening in the adductor magnus it is to the outer side, and close to the artery. Branches. — It is joined by branches corresponding to those of the artery, as well as by the short saphenous vein.

Popliteal artery may — *Peculiarities of the vessels.*—The chief peculiarity of the popliteal artery consists in its early division into its terminal branches. In some

bodies the artery is found divided as high as the back of the joint, and in such instances the anterior tibial artery may lie beneath the popliteus muscle. divide soon.

The popliteal vein may pass through the adductor magnus at a spot higher than the common opening, to enter the profunda vein. Or there may be a venous trunk on each side of the artery for a certain distance, in consequence of the venæ comites of the tibial arteries not being blended together as soon as usual. Vein may leave the artery or be split.

The POPLITEAL NERVES are two large trunks that are derived from the division of the great sciatic in the thigh; they are named internal and external from their relative position. In the ham each furnishes cutaneous and articular offsets, but only the inner one supplies branches to muscles. Popliteal nerves are two, inner and outer.

A. The *internal popliteal* nerve is larger than the external, and occupies the middle of the ham. Its connections are the same as those of the artery, that is to say, it is partly superficial and partly covered by the gastrocnemius: like the vessel it extends through the back of the leg, and retains the name popliteal only to the lower border of the popliteus muscle. Its position with reference to the vessels has been already noticed. The branches that arise from it here are now to be described:— The internal nerve in the space.

Branches are

Two or three small *articular* twigs are furnished to the knee-joint with the vessels. One is with the lower internal artery, and is of considerable size; and another takes the same course as the azygos artery. Occasionally a third may be found with the upper internal articular artery. two or three articular;

Muscular branches arise from the nerve between the heads of the gastrocnemius. One supplies both heads of the gastrocnemius and the plantaris; another descends beneath that superficial muscle of the leg to enter the cutaneous surface of the soleus; and a third penetrates the popliteus at the under aspect after turning round its lower border. to the superficial muscles of the leg and popliteus;

The *external saphenous* nerve (ram. communicans tibialis) is the largest branch, and is a cutaneous offset to the leg and foot. It lies on the surface of the gastrocnemius, but beneath the fascia, to about the middle of the leg, where it becomes cutaneous, as will be afterwards seen (p. 658.). external saphenous nerve.

B. The *external popliteal nerve* (peroneal) lies along the outer boundary of the ham, and follows the biceps muscle to External popl nerve.

the head of the fibula. Here the nerve enters the fibres of the peroneus longus muscle, and divides beneath it into two, musculo-cutaneous and anterior tibial. Its branches whilst in the popliteal cavity are cutaneous and articular.

Branches;

one articular.

The *articular* nerve runs with the upper external artery to the outer side of the knee, where it gives a twig to the lower articular artery, and enters the joint.

A communicating branch.

The *peroneal communicating* branch (ram. communicans fibularis) is a cutaneous nerve, and joins the external saphenous branch of the internal popliteal about the middle of the leg. It arises near the head of the fibula, and soon pierces the deep fascia; cutaneous offsets are given by it to the back of the leg.

Cutaneous offsets.

One or two other *cutaneous* offsets are furnished by the external popliteal to the integument on the outer part of the upper half of the leg.

Articular nerve of the obturator.

The *articular* branch of the *obturator nerve* perforates the adductor magnus, and is conducted by the popliteal artery to the back of the knee-joint. After supplying filaments to the vessel, the nerve enters the articulation through the posterior ligament.

Lymphatic glands around the artery.

The *lymphatic glands* of the popliteal space are joined by the deep lymphatic vessels of the lower limb, and are situate around the large arterial trunk. Two or three are ranged on the sides, whilst one is superficial to, and another beneath the vessel.

Dissect the back of the thigh.

Dissection. — Now the anatomy of the popliteal space has been learnt, the student is to proceed with the dissection of the back of the thigh. Divide therefore the piece of skin that remains between the buttock and the popliteal space, and reflect it to the sides.

Seek out cutaneous nerves.

In the fat on the sides of the limb may be found offsets of the internal and external cutaneous nerves of the front of the thigh, and along the middle line some filaments from the small sciatic nerve.

Clean muscles and nerves.

Lastly, remove the deep fascia of the limb, taking care of the small sciatic nerve; and then clean the hamstring muscles, and trace into them the branches of the great sciatic nerve.

Three muscles on back of thigh.

The *muscles* on the *back of the thigh* act as flexors of the leg. They extend from the pelvis to the bones of the leg, and are named hamstrings from their cord-like appearance on the sides of the ham; they are three in number, viz. biceps,

semitendinosus, and semimembranosus; the first of these lies on the outer, and the others on the inner side of the popliteal space. Situation.

The BICEPS has two heads of *origin*, long and short, which are connected with the pelvis and the femur. The long head arises from the back of the tuberosity of the ischium, in common with the semitendinosus muscle: the short head is fixed to the linea aspera, nearly as high as the gluteus maximus; to nearly the whole of the line leading inferiorly to the outer condyle; and to the external intermuscular septum. The fibres from these sources are collected together to form the belly of the muscle, and end inferiorly in a tendon, which is *inserted* into the head of the fibula by two processes that embrace the external lateral ligament. The muscle is superficial, except at the origin, where it is covered by the gluteus; and it rests on the upper part of the semimembranosus, on the great sciatic nerve, and on the adductor magnus muscle. On the inner side is the semitendinosus muscle as far as the ham. Its tendon gives offsets to the deep fascia of the limb. Biceps arises by a long and a short head; is inserted into the fibula. Connections of the muscle.

The SEMITENDINOSUS is a slender muscle, and receives its name from its appearance. It *arises* by fleshy fibres from the tuberosity of the ischium with the long head of the biceps, and is *inserted* into the inner surface of the tibia at the upper part, below the gracilis. This muscle, like the biceps, is partly covered by the gluteus maximus, and rests on the semimembranosus, and on the internal lateral ligament of the knee-joint; a tendinous intersection is to be observed about its middle. The outer border is in contact with the biceps as far as the popliteal space. As the tendon turns forwards to its insertion, an expansion is continued from it to the fascia of the leg. Semitendinosus is attached to pelvis and tibia. Surrounding parts in contact with it.

The SEMIMEMBRANOSUS muscle is tendinous at both ends, and its name is taken from the membraniform appearance of the upper tendon. Attached above to the tuberosity of the ischium external to the semitendinosus and biceps, it is *inserted* below into the inner side of the head of the tibia. The muscle presents a thick fleshy belly at the lower part, where it bounds the popliteal space: on it is the semiten- Semimembranosus reaches from pelvis to tibia.

Parts around it. dinosus, which is lodged in a hollow in the upper tendon; and beneath it is the adductor magnus. Along the outer border are placed the great sciatic nerve, and its inner branch (internal popliteal). The insertion of the muscle is dissected with the tendons in connection with the knee-joint.

Great sciatic nerve in the thigh The *great sciatic nerve* lies on the adductor magnus between the buttock and the popliteal space, and divides into the two popliteal nerves about the middle of the thigh, though its point of bifurcation may be carried upwards as far as the pelvis. In this extent the nerve lies along the outer border of the semimembranosus, and is crossed by the long head of the biceps. At its upper part it supplies branches to the flexor muscles at the back of the thick, as well as to the adductor magnus. (supplies flexor muscles.)

Small sciatic in the thigh; *Small sciatic nerve.* — Between the gluteus and the ham this small nerve is close beneath the fascia, but it becomes cutaneous below the knee, and runs with the external or posterior saphenous vein for a short distance. Small *cutaneous* filaments pierce the fascia, and the largest of these is near the popliteal space. (cutaneous offsets.)

Detach the hamstrings. *Dissection.*— Detach the hamstring muscles from the tuberosity of the ischium, and throw them down, after cutting the branches of arteries and nerves they receive. The posterior surface of the adductor magnus, and the branches of the perforating arteries, are then to be cleaned.

Posterior aspect of adductor magnus. *Adductor magnus.* — At its posterior aspect the large adductor is altogether fleshy, even to the opening for the femoral artery; and the fibres from the rami of the pubis and ischium appear to form a part almost distinct from those connected with the tuberosity of the ischium. In contact with this surface are the hamstring muscles, and the great sciatic nerve.

Hip-joint, how formed; The Hip-joint. — This articulation is a ball and socket-joint, in which the head of the femur is received into the acetabulum, or the cup-shaped cavity of the innominate bone. Connecting the bones are the following ligaments: — one to deepen the receiving cavity, which is named cotyloid; (its ligaments.)

another between the articular surfaces of the bones, the interarticular; and a loose capsule around all.

Dissection. — The muscles are to be taken away from the back of the hip-joint, and the upper and lower attachments of the capsular ligament defined. Afterwards the front of the joint should be dissected after the same manner, with the body turned over if it can be done. Lay bare the capsule.

The *capsular ligament* is a loose fibrous covering that is fixed by one end around the acetabulum, and by the other to the neck of the femur. Capsule. Its upper margin is attached to the circumference of the acetabular cavity at a short distance from the edge, as well as to a transverse ligamentous band over the notch at the inner side of the hollow. Attachments above Its lower margin is inserted in front into the anterior trochanteric line, and behind into the neck of the femur about a finger's breadth from the posterior trochanteric line, and the trochanters. and below. The capsule is thinnest below, where it is in contact with the obturator externus; but in front it is thickened by a band of fibres — *ilio-femoral* ligament, which crosses from the lower of the two anterior spines of the ilium to the trochanteric line. On the front is a band of fibres. Posteriorly the joint is covered by the external rotator muscles; anteriorly by the psoas and iliacus, and a bursa; and below by the obturator externus. Muscles around.

Dissection — Divide the capsular ligament over the prominence of the head of the femur, and disarticulate the bone to see the cotyloid and interarticular ligaments. Cut open the capsule.

The *cotyloid ligament* is a band of fibro-cartilage, which is fixed to the margin of the acetabulum, and is prolonged across the notch on the inner side, so as to give rise to the *transverse* ligament. Cotyloid ligament forms transverse, It is thickest at its attachment to the bone, and becomes gradually thinner towards the free margin, which is applied to the head of the femur. attached around acetabulum. This ligament deepens the socket for the femur in the same manner as the glenoid ligament increases the surface for the reception of the head of the humerus.

The *interarticular ligament* (ligam. teres) is a strong band which connects the femur with the innominate bone. Round ligament One extremity is roundish, and is inserted into the pit in the

is divided externally. head of the femur; the other is bifid, and is connected to the sides of the notch in the cotyloid cavity.

Synovial membrane. A *synovial membrane* lines the capsular ligament, and is continued over the neck and head of the femur to the acetabulum. In the bottom of the cotyloid cavity it covers the mass known as the synovial gland, and surrounds the ligamentum teres.

Detach the limb. *Dissection.* — The lower limb is now to be separated from the trunk by dividing the interarticular ligament, and cutting through any parts that attach it, to see the acetabulum.

Articular surfaces of the bones. *Surfaces of bone.* — The articular surfaces of the bones are for the most part covered with cartilage, but in the head of the femur is a pit into which the round ligament is inserted; and in the bottom of the acetabulum is a space free from cartilage, in which is lodged a reddish fatty mass with an unctuous feel, called the *synovial gland.* Beneath the transverse ligament branches of an artery and nerve enter the joint. (Synovial gland.)

SECTION IV.

THE BACK OF THE LEG.

Examine the surface. BEFORE the dissection of the leg is begun, the student should make himself acquainted, as in the thigh, with the prominences of bone or muscle on the surface, and with the markings that lead to the position of the subjacent vessels.

In the leg the tibia and fibula are superficial. *Marks on the surface.* — The bones of the leg can be traced beneath the skin from the knee to the ankle-joint. On the inner side of the limb the tibia is subcutaneous in all its extent, and is limited internally and externally by a sharp ridge. Above, it presents in front a prominent tubercle into which the ligament of the patella is inserted; and below, it ends on the inner side of the ankle in the internal malleolar projection. On the outer side of the leg the fibula may be felt with ease in the lower half of its length, but with more difficulty in the upper half in consequence of the prominence of the muscles of the calf: the head of the bone

may be recognised below the knee; and the lower end forms the projection (malleolus) on the outer side of the ankle-joint. The calf of the leg is formed by the superficial layer of muscles, and from it descends the firm band of the tendo Achillis, by which those muscles are connected with the heel. Between the tendon and the edge of the tibia, but nearest the former, is the part of the posterior tibial artery that is superficial. In front, between the tibia and fibula, are the extensor muscles of the foot and toe, amongst which the anterior tibial artery lies deeply: the position of the vessel will be indicated by a line from the centre of the ankle-joint to a point midway between the upper ends of the bones. Calf of the leg. Tendo Achillis. Tibial vessels posterior and anterior.

On the sides of the ankle-joint are the prominent malleoli, and when the joint is extended the head of the astragalus projects below the border of the tibia. Ankle-joint.

At the inner border of the foot, about an inch from the internal malleolus, is the prominent scaphoid bone pointing out the spot at which an amputation (that of Chopart) is made; whilst farther forwards, by about one inch and a half, is a slight depression that marks the articulation between the internal cuneiform bone and the metatarsal bone of the great toe. About the centre of the outer border of the foot is the eminence of the tarsal end of the fifth metatarsal bone. A line over the dorsum of the foot, from the centre of the ankle-joint to the interval between the two inner toes, will be over the position of the artery of this part. Inner border of the foot. Outer border. Dorsal artery.

Position. — For the dissection of the back of the leg the limb is to be placed on its front, with the foot over the side of the dissecting table, and the muscles of the calf are to be put on the stretch by fastening the foot. Position of the part.

Dissection. — Divide the skin along the middle of the leg to the sole of the foot, where a transverse cut is to be made over the heel. Raise the two flaps of skin, detaching the outer one as far as the fibula, and the other to the inner margin of the tibia. Take away the skin.

In the superficial fascia the cutaneous nerves and vessels are to be followed. On the inner side, close to the tibia, is the internal saphenous vein with the nerve of the same name, together with twigs of the internal cutaneous near the knee. In the centre is the Seek cutaneous nerves in the fat.

external saphenous vein, with the small sciatic nerve above, and with the external saphenous nerve below the middle of the leg. On the outer side are the cutaneous offsets of the external popliteal nerve.

Superficial fascia. The *superficial fascia* or the fatty layer of the back of the leg is least in quantity over the tibia. Where the superficial vessels are situate it may be separated into two layers as in the thigh.

Two superficial veins. Superficial Veins. — Two veins appear in this dissection of the back of the leg which are named saphenous, inner and outer.

Internal saphenous. The *internal saphenous* vein begins in an arch on the dorsum of the foot, and ascends along the leg in front of the inner ankle, and then behind the inner edge of the tibia to reach the thigh, where it has been already noticed (p. 602.). In the leg the vein is joined by both superficial and deep branches.

External saphenous. The *external saphenous* vein begins at the outer end of the arch on the dorsum of the foot, and appears below the outer ankle. The vein then courses along the back of the leg to the ham, where it ends in the popliteal vein. It receives large branches about the heel, and others on the back of the leg.

Cutaneous nerves. Cutanous Nerves. — The nerves in the superficial fascia of the back of the leg are prolongations of branches already examined in part, viz. the internal and external saphenous, cutaneous offsets of the external popliteal, the small sciatic nerve, and offsets of the internal cutaneous of the thigh.

Internal saphenous in the leg. *The internal saphenous* nerve, which has been traced before to the knee (p. 605.), accompanies the vein of the same name in the leg nearly to the end of the tibia, where it divides into two branches: — one continues along the edge of the tibia to the integument about the inner ankle; the other extends as far as the middle of the inner border of the foot. Termination. In the leg the nerve gives off lateral cutaneous offsets, and the outer of these turn over the tibia to the anterior aspect.

External saphenous The *external saphenous* nerve is a branch of the internal popliteal (p. 651.); perforating the deep fascia about the middle of the leg,

it is continued with the external saphenous vein below the outer ankle, and is distributed to the outer side of the foot and little toe. As soon as the nerve appears it is joined by the communicating branch of the external popliteal, and near the heel it gives large long branches to the integuments.

ends on the foot; branches to the leg.

Cutaneous nerves of the external popliteal.—One branch of the external popliteal trunk (r. communicans fibularis, p. 652.) joins the external saphenous nerve usually about the middle of the leg, but it is not uncommon to find this branch extend as a distinct nerve, unconnected with the other, as far as the heel. The other small *cutaneous* offsets of the external popliteal are now dissected to their termination over the outer side of the leg.

Branches of the popliteal communicating and cutaneous.

The *small sciatic* nerve perforates the fascia near the popliteal space, and reaches with the external saphenous vein to about the middle of the leg; it ramifies in the integuments, and joins the external saphenous nerve.

Termination of small sciatic.

Offsets of the internal cutaneous.—Behind the internal saphenous nerve, near the knee, are the terminal branches of the inner division of the internal cutaneous nerve of the thigh (p. 604.); these extend to the middle or the lower third of the leg, and communicate with the internal saphenous nerve.

Termination of internal cutaneous.

Dissection.—The deep fascia will be seen by removing the fat. The superficial vessels and nerves may either be cut or turned aside.

Take away the fat.

The special or deep *fascia* on the posterior aspect of the leg covers the muscles, and sends a thick process between the deep and superficial layers. Above it is continuous with the investing membrane of the thigh, and receives offsets from the tendons about the knee; below it joins the internal annular ligament. Externally it is continued uninterruptedly from one aspect of the limb to another, but internally it is fixed to the edge of the tibia. Veins are transmitted through it from the superficial to the deep vessels.

Deep fascia.

Continuation and attachment.

Dissection.—The fascia is to be divided along the centre of the leg as far as the heel, and taken from the surface of the gastrocnemius muscle. The cleaning the fibres of the muscle will be facilitated by fixing with a stitch the inner head that has been cut.

Take away the fascia.

Superficial layer of muscles.—In the calf of the leg there are three muscles, gastrocnemius, soleus, and plantaris: the two first are large, and give rise to the prominence on the

Muscles in superficial layer.

surface, but the last is inconsiderable in size and is chiefly tendinous.

Gastrocnemius

The GASTROCNEMIUS is the most superficial muscle; it is united below in a common tendon, but has two heads above, which connect it with the condyles of the femur.

arises by two heads from the femur,

The inner head of *origin* is attached by a tendon to the inner condyle behind the insertion of the adductor magnus, and by fleshy fibres to the line above the condyle; and the outer head is fixed to the corresponding condyle above the

ends below in tendo Achillis.

attachment of the popliteus muscle. These pieces are blended inferiorly in a large fleshy belly, and are terminated by the common tendon of insertion of the muscles of the

Parts covered by it.

superficial layer. One surface is covered by the fascia, and the other is in contact with the soleus and plantaris, and with the popliteal vessels and the internal popliteal nerve. The heads by which the muscle arises assist to form the lateral boundaries of the popliteal space.

Detach part of gastrocnemius.

Dissection. — To see the soleus, detach the remaining head of the gastrocnemius, cutting across the vessels and nerves it receives. Throw down the muscle, and clean the soleus and the plantaris.

Soleus

The SOLEUS is a large flat muscle that is attached to both bones of the leg, and terminates, like the gastrocnemius, in

is attached to the bones of the leg,

the strong common tendon. It *arises* from the head and the upper third of the posterior surface of the fibula; from the oblique line across the tibia, and from the inner edge of the bone in its middle third; and between the bones from an aponeurotic arch over the large blood-vessels. Its fibres

and joins below the tendon.

are directed downwards and outwards to the aponeurotic part of the muscle. The superficial part of the soleus is in contact with the gastrocnemius, and the opposed surfaces of the two are aponeurotic. Beneath the muscle are the bones of the leg, the deep layer of flexors, and the vessels and nerves.

Tendo Achillis.

The *common tendon* of the gastrocnemius, soleus, and plantaris (tendo Achillis) is the strongest in the body; it com-

Extent

mences about the middle of the leg, though it receives fleshy

and insertion.

fibres much lower, and is *inserted* into the lower part of the os calcis at the posterior aspect, but a bursa intervenes be-

tween it and the upper part of that bone. The tendon is close beneath the fascia, and lying along its outer side, but superficial to it, is the external saphenous vein.

The PLANTARIS is remarkable in having the longest tendon in the body, which has somewhat the appearance of a riband when it is stretched laterally. The fibres of the muscle *arise* from the line above the outer condyle of the femur, and from the posterior ligament of the knee joint, and soon end in the tendon which is *inserted* into the os calcis with or by the side of the tendo Achillis. The belly of the muscle, which is about three inches in length, is concealed by the gastrocnemius, but the tendon appears on the inner side of the tendo Achillis about the middle of the leg. This little muscle crosses the popliteal vessels, and lies on the soleus.

Plantaris arises from the outer condyle, and joins common tendon.

Dissection.—The soleus is to be detached from the bones of the leg, and the vessels and nerves it receives divided, but in raising it the student should take care not to injure the fascia and the deep vessels and nerves. The gastrocnemius and soleus may next be removed by cutting through their tendon near the os calcis. Then the piece of fascia between the muscles of the superficial and deep layer is to be cleaned; and the integuments between the inner ankle and the heel are to be taken away to expose the annular ligament, but a cutaneous nerve in this spot to the sole of the foot is not to be destroyed. Lastly the student should open the bursa between the tendo Achillis and the os calcis, if this has not been done.

Detach soleus, and clean the deep fascia.

Deep part of the fascia.—This intermuscular layer of the fascia of the leg is fixed to the tibia and fibula, and binds down the deep layer of flexor muscles. Beneath the soleus it is thin and indistinct, but below that muscle it is much stronger, and is marked by some transverse fibres near the malleoli, which give it the appearance of an annular ligament in that situation. Inferiorly it joins the annular ligament between the heel and the inner ankle.

Deep part of the fascia of the leg.

Dissection.—Remove the fascia, and clean the deep layer of muscles. At the same time follow carefully the trunks and offsets of the posterior tibial and peroneal vessels, and of the nerve. The muscle between the bones (tibialis posticus) is partly concealed by an aponeurosis which gives origin to the flexors on its sides, and will not fully appear till that is divided.

Clean the deep muscles.

Four muscles in the deep layer.

Deep layer of muscles.—The deep flexor muscles at the back of the leg are four in number, viz. popliteus, flexor longus pollicis, flexor longus digitorum, and tibialis posticus. The first of these is close to the knee-joint, covered by a special aponeurosis. The flexors lie on the bones, that of the great toe being on the fibula, and that of the other toes on the tibia; whilst the last muscle covers the membrane between the bones. With the exception of the popliteus, all enter the sole of the foot, and have a fleshy part parallel to the bones of the leg, and a tendinous part beneath the tarsus.

Position and destination.

Popliteus arises within knee-joint.

The POPLITEUS is attached within the capsule of the knee-joint by a tendon to the fore part of a depression on the outer condyle of the femur, below the external lateral ligament. External to the joint the tendon gives attachment to the fleshy fibres which spread out, and are *inserted* into the tibia above the oblique line on the posterior surface. The muscle lies on the tibia, and is covered by a fascia, derived in great part from the tendon of the semimembranosus muscle. On it lie the popliteal vessels and nerve, with the gastrocnemius and plantaris. Along the upper border are the lower articular vessels and nerve of the inner side of the knee, but the insertion corresponds to the origin of the soleus from the tibia. The origin of the muscle is seen with the dissection of the ligaments of the knee-joint.

Inserted into tibia.

Parts around it.

Flexor longus pollicis is attached to fibula,

The FLEXOR LONGUS POLLICIS PEDIS arises from the two lower thirds of the posterior surface of the fibula, slightly from the lower part of the interosseous membrane, and from the aponeurosis over the tibialis. Inferiorly the tendon of the muscle enters a groove in the astragalus, and afterwards crosses the sole of the foot to reach the great toe. In part the muscle is covered by the soleus, but in part is superficial and in contact with the fascia; it rests on the fibula and lower end of the tibia, and conceals the peroneal vessels. Along the inner side are the posterior tibial nerve and vessels, and contiguous to the outer margin, but separated by fascia, are the peronei muscles.

is partly superficial.

Muscles and vessels on sides.

Flexor longus digitorum lies on tibia;

The FLEXOR LONGUS DIGITORUM PEDIS has some fibres of origin from the aponeurosis covering the tibialis muscle, and is connected with the posterior surface of the tibia below the

popliteus, as low as three inches from the extremity. Its tendon enters a partition in the annular ligament behind the sheath for the tibialis, and escaped from the ligament divides in the sole of the foot into tendons for the four outer toes. Part of the muscle is beneath the soleus; but below that it is in contact with the fascia, and the posterior tibial nerve and vessels lie on it. The deep surface rests on the tibia, and on the tibialis posticus.

in the ligament; part is superficial below soleus.

The TIBIALIS POSTICUS occupies the interval between the bones of the leg, but inferiorly it crosses beneath the long flexor of the toes to reach the inner side of the foot. The muscle *arises* from the posterior surface of the interosseous membrane, from the contiguous surfaces of the tibia and fibula, but most from the tibia, and from the aponeurosis that covers it. Having crossed beneath the flexor digitorum, the tendon enters the inner space in the annular ligament, and reaches the inner side of the foot to be inserted into the scaphoid bone. The tibialis is concealed by the aponeurosis before mentioned, and is overlapped by the contiguous muscles, but in the lower fourth of the leg it is placed between the tibia and the long flexor of the toes: on the muscle too are the posterior tibial vessels and nerve. The upper part presents two pointed processes of attachment to the bones, between which the anterior tibial vessels are directed forwards.

Tibialis covers interosseous membrane, crosses beneath the flexor of the toes. Muscles and vessels in connection with it.

The aponeurosis covering the tibialis is attached laterally to the bones, but has a defined border inferiorly over the muscle. By one surface it gives origin to the flexors of the toes, and by the other to the tibialis.

The muscle covered by an aponeurosis.

The POSTERIOR TIBIAL ARTERY is one of the branches resulting from the bifurcation of the popliteal trunk. The trunk of the vessel extends from the lower border of the popliteus muscle to the lower part of the internal annular ligament, where it enters the sole of the foot, and ends in two plantar branches. At its origin the artery lies midway between the tibia and fibula, but as it approaches the lower part of the leg it gradually inclines inwards, and at its termination is placed below the tibia, in the centre of the hollow between the heel and inner ankle.

Extent. Course.

Parts covering the upper and lower half

As far as the middle of the leg (in length) the vessel is concealed by two muscles of the calf, viz. the gastrocnemius and soleus, but below them it is covered only by the integuments and the deep fascia as it lies between the tendo Achillis and the inner edge of the tibia; at its termination it is beneath the annular ligament.

Parts beneath it.

For the greatest part of its extent the arterial trunk lies over the tibialis posticus, but afterwards on the flexor digitorum, and on the lower end of the tibia.

Veins.

Venæ comites (posterior tibial veins) closely surround the vessel.

Nerve.

The posterior tibial nerve is at first internal to the artery, but at the distance of one inch and a half it is placed on the outer side, and retains that position throughout.

Branches.

This artery supplies *branches* to the muscles and the tibia, and a large peroneal trunk to the outer side of the leg.

Muscular.

Muscular branches supply the deep layer of muscles and the soleus; an offset from a branch to the latter muscle pierces the fleshy attachment to the tibia, and ascends to the knee-joint.

Nutritious to tibia.

A *nutritious* artery of the tibia is uncertain in its place of origin, but it enters the canal on the posterior surface of the bone, and ramifies in the interior.

Communicating.

A *communicating* branch to the peroneal arises opposite the lower end of the tibia, and passes outwards beneath the flexor pollicis, to unite in an arch with a corresponding offset of the peroneal artery.

Peroneal artery

The *peroneal artery* is often as large as the posterior tibial, and arises from that vessel about one inch and a half from the beginning.

is contained in flexor pollicis.

It takes the fibula as its guide, and lying close to the bone in the fibres of the flexor pollicis, reaches the lower part of the interosseous membrane. At this spot it sends forwards a branch to the front of the leg (anterior peroneal), and continues over the articulation between the tibia and fibula to the outer side of the foot, where it

Termination.

terminates in branches that anastomose with the tarsal and external plantar arteries. Two companion veins surround the artery.

Branches.

Branches. — Besides the anterior peroneal, it furnishes muscular, nutritious, and communicating offsets.

Muscular.

Muscular branches are distributed to the soleus and the deep flexors, and some turn round the fibula to the peronei muscles.

The *nutritious* artery is smaller than that to the tibia, and enters the aperture about the middle of the fibula. Nutritious to fibula.

The *anterior peroneal* branch passes forwards through an aperture in the lower part of the interosseous membrane, and is directed in front of the fibula to the dorsum and outer part of the foot: on the front of the leg and foot it anastomoses with the external malleolar and tarsal branches of the anterior tibial artery. Anterior peroneal to front of foot.

A *communicating* offset near the ankle joint joins in an arch, as before described, with a similar branch of the posterior tibial; sometimes there is a second arch between the same vessels. Communicating.

Peculiarities in the arteries.—The posterior tibial artery may be smaller than usual, or absent; its place will then be supplied in the foot by a large peroneal artery, that is directed inwards at the lower end of the tibia, and either joins the small tibial vessel, or runs alone to the foot. The peroneal artery may arise from the popliteal, or from the anterior tibial artery; and its anterior peroneal branch may take the place of the anterior tibial artery on the dorsum of the foot. Thus the deficiency in one of the arteries of the foot is supplied by a large offset of the other. Size of tibial changes. Origin of peroneal varies. Substitutions.

The *posterior tibial veins* begin on the inner side of the foot by the union of the plantar veins; they ascend one on each side of their artery, and unite with the anterior tibial veins at the lower border of the popliteus to form the large popliteal vein. They receive the peroneal veins, and branches corresponding to the offsets of the artery: further, branches connect them with the saphenous veins. Posterior tibial veins.

The *posterior tibial nerve* is a continuation of the internal popliteal, and reaches, like the artery, from the lower border of the popliteus muscle to the interval between the os calcis and the inner malleolus. Near this spot, whilst beneath the annular ligament or somewhat higher than it, the nerve divides into the internal and external plantar branches of the foot. Its connections with surrounding parts are the same as those of the artery; but its position to the vessels changes, for it lies on the inner side of the posterior tibial artery above the origin of the peroneal offset, but on the outer side thence to its termination. Its lateral branches are chiefly muscular. Posterior tibial nerve. Extent and connections. Position to the artery. Branches.

Muscular branches enter the deep flexors, and arise either at separate points along the trunk, or together from the popliteal Muscular to the deep flexors.

nerve. There is an offset for each muscle, except the popliteus, but the branch for the tibialis is the largest, and that for the flexor pollicis lies on the peroneal artery.

Cutaneous of the foot. A *cutaneous nerve* of the *sole* of the *foot* pierces the internal annular ligament, and ends in the integument of the inner and under part of the heel; this nerve will be followed to its termination in the dissection of the foot.

Internal annular ligament. The *internal annular ligament* is placed between the heel and inner ankle, and serves to confine the tendons of the deep flexor muscles of the foot and toes. Attachments. Attached by a pointed part to the internal malleolus, the fibres diverge therefrom to be inserted into the os calcis. One border (upper) is continuous with the fascia of the leg, and the opposite one gives attachment to the abductor pollicis muscle of the foot. Processes of it separate the tendons, forming sheaths; From the under or deep surface are given off processes, that separate and form sheaths for the tendons. When the sheaths are opened, the innermost will be found to contain the tibialis posticus, which is lodged in a groove in their position; the malleolus: immediately behind this is another space for the flexor digitorum; and about three quarters of an inch nearer the os calcis, is the interval in which the flexor pollicis lies contained in a groove in the astragalus. lined by synovial membrane. Each sheath is lined by a synovial membrane.

Tibial vessels and nerve beneath the ligament. *Vessels beneath the ligament.* — The posterior tibial vessels in passing beneath the ligament lie between the tendons of the flexor pollicis and flexor digitorum, but rather nearer the latter; and the artery here supplies small *offsets* to the tarsus and the ankle-joint. Occasionally the artery divides beneath, or even above the ligament. The nerve is nearer than the artery to the os calcis, and is sometimes bifurcated beneath the ligament, so that a trunk may lie on each side of the tibial vessels.

SECTION V.

THE SOLE OF THE FOOT.

Position. — THE foot is to be placed over a block of some thickness with the sole towards the dissector, and the part is to be made tense by fastening down, and separating the toes. Position of the part.

Dissection. — The skin is to be raised as two flaps, inner and outer, by means of one incision along the centre of the sole from the heel to the anterior part, and by another across the foot at the root of the toes. Afterwards the skin is to be removed from each toe, and the lateral digital vessels and nerves are to be dissected out at the same time. In the fat near the heel the student should follow the cutaneous nerve of the sole of the foot, and trace out, at a little distance from each border of the foot, some small branches of the plantar nerves and arteries. Raise the skin and dissect cutaneous nerves.

The *subcutaneous fat* of the sole of the foot is very abundant, and forms the thickest cushion over the parts that press most on the ground in standing, viz. over the os calcis, and the line of the metatarso-phalangeal articulations. Subcutaneous fat.

Dissection. — The fat is now to be removed, and the plantar fascia laid bare. Begin the dissection near the heel, and follow forwards the fascia towards the toes, to each of which a process is to be traced. In the intervals between these processes the digital nerves and arteries will be found, covered by much cellular and fibrous tissue; but the vessels and nerves to the inner side of the great toe and outer side of the little toe pierce the fascia farther back than the rest. Lay bare the plantar fascia, and the digital vessels and nerves.

The student is next to define a transverse fibrous band between the toes over the digital vessels and nerves; and when this is dissected, to remove the fat from the toes to see the sheaths of the tendons. Define the ligament of the toes.

Plantar fascia. — The special fascia of the sole of the foot is of a pearly white colour and great strength, and sends septa between the muscles. Its thickness varies in different parts of the foot, and from this circumstance, and from the existence of longitudinal hollows where the two chief inter- Plantar fascia.

Division into parts. muscular septa are attached, the fascia is divided into a central and two lateral parts.

Central part The central part, which is much the thickest, is pointed at its attachment to the os calcis, but widens and becomes thinner as it extends forwards. Opposite the heads of the divides into five pieces. metatarsal bones it divides into five processes which are continued onwards to the toes, one to each. If one of the processes is divided longitudinally, and its parts reflected to Termination of the pieces. the sides, it will be seen to join in the centre the sheath of the flexor tendons, whilst on the sides it is attached to the margins of the metatarsal bone, and to the ligament uniting Arched fibres over vessels. one bone to another. Where the processes separate from one another, the digital vessels and nerves and the lumbricales muscles become superficial, and transverse fibres arch over them in these intervals. A slight depression, corresponding to an intermuscular septum, marks on each side the limit of the central piece.

Inner part of the fascia; The lateral parts of the fascia are thinner than the central one. On the inner margin of the foot the fascia has but little strength, and is continued to the dorsum; but on outer part. the outer side it is increased in thickness, and presents a strong band between the os calcis and the projection of the fifth metatarsal bone.

Expose the septa. *Dissection.*—To examine the septa make a longitudinal incision along the centre of the foot, and a transverse one near the calcaneum. On detaching the fascia from the subjacent flexor brevis digitorum, by carrying the scalpel from before backwards, the processes will appear on the sides of that muscle.

Two intermuscular septa; The *intermuscular septa* pass down on the sides of the flexor brevis digitorum, and separate the three muscles in the superficial layer of the sole of the foot. The inner one lies inner between the short flexor and the abductor pollicis, and is perforated by the internal plantar nerve, and by the tendon and outer. of the flexor pollicis longus. The outer one, between the short flexor and the abductor minimi digiti, is pierced by the digital nerve and artery for the outer side of the little toe. A piece of fascia reaches across the foot from one septum to the other, beneath the short flexor.

The *transverse ligament* crosses the roots of the toes, and is contained in the skin forming the web of the foot. It is a band of fibres which is attached at the extremities to the great and little toes, and is connected with the sheath of the tendons of each of the others, as it passes over it. Beneath it are the digital nerves and vessels. Transverse ligament of the toes.

The *sheaths* of the *flexor tendons* are similar to those of the fingers though not so distinct, and serve to confine the tendons against the grooved bones. The sheath is weak opposite the articulations between the phalanges, but is strengthened by a band opposite the centre of both the metatarsal and the next phalanx. Each is lubricated by a synovial membrane, and contains a tendon of both the long and short flexor muscle. Sheaths of flexor tendons.

Dissection.—To prepare the first layer of muscles of the foot, take away all the fascia, and be careful of the digital branches of the plantar nerves, which become superficial to the muscles towards the toes. Follow the tendons of the short flexor muscle to the toes, and open the sheaths in which they are contained. Dissect first layer of muscles.

Muscles of the foot. — In the sole of the foot the muscles are numerous, and have been arranged in four layers. In the first layer, which is now visible, are three muscles, viz., the flexor brevis digitorum, the abductor pollicis, and abductor minimi digiti. One of these, the short flexor of the toes, is in the centre of the foot, and each of the others is in a line with the toe on which it acts. Muscles are in four layers; three muscles in the first.

The ABDUCTOR POLLICIS is the most internal of the muscles of the superficial layer, and is bifurcated at its posterior attachment. It takes *origin* from the internal annular ligament, from the larger tubercle on the under part of the os calcis, and from the fascia of the foot. In front the muscle ends in a tendon, which is joined by fibres of the short flexor of the great toe, and is *inserted*, with the tendon of the same, into the inner side of the metatarsal phalanx of the great toe, at the base. The cutaneous surface of the muscle is in contact with the plantar fascia; and the other touches the plantar vessels and nerves, the tendons of the long flexors of the toes, and the accessory muscle. Abductor pollicis: origin; insertion; connections.

Flexor brevis digitorum

The FLEXOR BREVIS DIGITORUM (flexor perforatus) *arises* posteriorly by a pointed part from the inner side of the larger tubercle of the os calcis, and from the plantar fascia and its septa. About the centre of the foot the muscle ends in four small tendons, which are directed forwards over the tendons of the long flexor, and enter the sheaths of the four smaller toes to be *inserted* into the middle phalanges. In the sheath of the toe the tendon of this muscle lies at first on that of the long flexor (in this position), but opposite the middle of the metatarsal phalanx it is slit for the passage of the other, and is attached by two processes to the sides of the middle phalanx. The short flexor of the toes is contained in a sheath of the plantar fascia, and occupies the middle of the foot: it conceals the tendon of the long flexor of the toes, the accessory muscle, and the external plantar vessels and nerve.

divides into tendons for the toes;

these are slit.

Connections.

Abductor of the little toe.

The ABDUCTOR MINIMI DIGITI has a wide *origin* behind from the outer and inner tubercles of the os calcis, and from the plantar fascia and the external intermuscular septum. It ends anteriorly in a tendon which is *inserted*, with the short flexor of the little toe, into the outer side of the metatarsal phalanx of that toe at the base. The muscle lies along the outer border of the foot, and conceals the flexor accessorius and the tendon of the peroneus longus. On its inner side are the external plantar vessels and nerve.

Origin and insertion.

Is at side of the foot.

Dissect plantar vessels and nerves.

Dissection.—To bring into view the second layer of muscles and the plantar vessels and nerves, reflect the muscles already examined. Cut through, therefore, the flexor brevis at the os calcis, and as it is raised notice a branch of nerve and artery to it; divide the abductor minimi digiti near its origin, and turn it to the outer side of the foot, and seek a small nerve and vessel to it close to the bone. The abductor pollicis may be drawn aside if it is necessary, but it may remain uncut till afterwards. Now follow the plantar vessels and nerves forwards to their termination, and backwards to their origin, and clean the tendons of the long flexors of the toes, the accessory muscle, and the small lumbricales.

Two plantar arteries:

The PLANTAR ARTERIES are the terminal branches of the posterior tibial trunk in the hollow of the heel. They are two in number, and are named external and internal from

Inner and outer.

their relative position in the sole of the foot. Of the two the former is the largest, and forms the plantar arch of arteries, from which digital branches are furnished to the toes.

Internal small; ends on side of the foot.

The *internal* artery is commonly inconsiderable in size, and is directed forwards under cover of the abductor pollicis to the root of the great toe; here it ends either in small branches to the side of the foot, or in the interval between the two inner toes by supplying digital branches to these, and anastomosing with an offset of the external plantar artery.

External artery has curved course; partly superficial, partly deep.

The *external* artery has an arched course in the foot, with the concavity of the arch turned inwards. Starting from the inner part of the foot, the vessel is first directed outwards across the sole, and then obliquely forwards towards the root of the great toe, or to the side on which it began, so that the vessel crosses twice the foot. In the first half of its extent, the artery is comparatively superficial, and extends from the inner side of the calcaneum to the base of the metatarsal bone of the little toe; in the other half it lies deeply in the foot, in contact with the interosseous muscles, and forms the plantar arch between the little and the great toe.

Superficial part. Connections. Veins and nerve. Branches.

Only the first part of the artery is now laid bare; the remaining part, that supplies the digital branches, will be noticed after the examination of the third layer of muscles (p. 676.). As far as the metatarsal bone of the little toe, the vessel is concealed at first by the abductor pollicis and the flexor brevis digitorum, but it then lies for a short distance in the interval between the last muscle and the abductor minimi digiti. In this part it is placed on the os calcis, and on the flexor accessorius; and is accompanied by venæ comites, and by the external plantar nerve. It supplies offsets to the muscles between which it lies, and some branches to the outer side of the foot to anastomose with the peroneal artery.

Plantar nerves also two

The PLANTAR NERVES are derived from the bifurcation of the posterior tibial nerve behind the inner ankle. They are two in number, like the arteries, and have the same connections as those vessels, for one accompanies a plantar

but the inner is largest. artery to the side of the foot; but the larger nerve is found with the smaller artery.

Internal nerve to three toes and a half. The *internal plantar* nerve courses with its artery between the short flexor and the abductor pollicis, and divides into four digital nerves for the supply of both sides of the three inner toes and half the fourth, thus resembling the median nerve in the hand in the number and distribution of its digital branches. Other branches. Offsets are given by it to the short flexor and the abductor pollicis, and a few superficial twigs perforate the fascia.

Digital nerves are divided except first; The *digital* nerves have a numerical designation, and the first is nearest the inner border of the foot. The branch to the inner side of the great toe is undivided, but the others are bifurcated at the cleft between the toes. Each of the three outer nerves, being give cutaneous, divided at the spot mentioned, supplies cutaneous offsets to the contiguous sides of two toes, and to the cutis beneath the nail; articular, also articular filaments to the joints, as in the fingers. Moreover, and muscular branches. muscular branches are furnished by the nerves before they reach the toes; thus, the first (most internal) supplies the flexor brevis pollicis, the second the inner lumbrical muscle, and the third the next lumbrical muscle.

External nerve to one toe and a half; The *external plantar* nerve furnishes the remaining digital nerves, viz., to both sides of the little toe, and the outer side of the next, and ends in the deep muscles of the sole of the foot, like the ulnar nerve in the hand. It has the same course as the external plantar artery, and divides at the outer has superficial and deep part. margin of the flexor brevis digitorum into a superficial and a deep part: the former gives origin to two digital nerves, but the latter accompanies the arch of the plantar artery deeply into the foot, and will be afterwards dissected. Whilst the external plantar nerve is concealed by the short flexor of Branches. the toes, it gives muscular branches to the abductor minimi digiti and flexor accessorius.

Two digital branches from superficial part. The *digital branches* of the external plantar nerve are but two, and resemble those of the ulnar nerve in the hand. One, which is undivided, is distributed to the outer side of the little toe, and gives branches to the flexor brevis minimi digiti, and to the interosseous muscles of the fourth space. One is undivided. The other bifurcates at the cleft between the two outer toes, and supplies their collateral

parts. This nerve communicates in the foot with the last digital branch of the internal plantar nerve. On the sides of the toes the digital nerves have the same distribution as those from the other plantar trunk.

Distribution like others.

Dissection.—To complete the preparation of the second layer of muscles, detach the origin of the abductor pollicis from the os calcis, and turn inwards the muscle. Cut across the internal plantar nerve and artery, also the superficial portion of the external plantar nerve, but not the deep part with the artery, and throw them forwards. Lastly, remove all the cellular membrane and the fascia from near the toes.

Lay bare second layer of muscles.

Second layer of muscles.—In this layer are the tendons of the two flexor muscles of the leg, viz., the flexor longus digitorum and flexor longus pollicis, which cross one another: connected with the former, soon after it enters the foot, is an accessory muscular slip, and at its division into pieces are four slender muscles named lumbricales.

Tendons and muscles of the second layer.

The tendon of the FLEXOR LONGUS DIGITORUM, whilst entering the foot beneath the internal annular ligament, lies on the internal lateral ligament of the ankle-joint. In the foot it is directed obliquely towards the centre, where it is joined by the flexor longus pollicis and the accessory muscle, and divides into tendons for the four outer toes. Each tendon enters the sheath of the toe with and beneath a tendon from the flexor brevis. About the centre of the metatarsal phalanx the tendon of the long flexor is transmitted through the other, and passes onwards to be *inserted* into the base of the ungual phalanx. The tendon of the flexor longus digitorum is sometimes increased in size by its junction with that of the long flexor of the great toe.

Tendon of the flexor of the toes.

divides into four.

These enter the sheaths of the outer toes and pierce the other tendons.

The LUMBRICALES are four small muscles between the tendons of the flexor longus digitorum. Each *arises* from two tendons, with the exception of the most internal, which is connected with the inner side of the tendon to the second toe; and is *inserted* into the tibial side of the base of the metatarsal phalanx of the four outer toes. From the insertion an expansion is prolonged to the dorsum of the phalanx to join the aponeurotic covering on it. These

Four lumbricales.

Attachment to toes and long flexor.

muscles decrease in size from the inner to the outer side of the foot.

Flexor accessorius

The FLEXOR ACCESSORIUS MUSCLE has one origin from the under surface of the os calcis and ligamentum longum plantæ, and another from the inner or concave surface of the calcaneum. The fibres end on the tendon of the flexor longus digitorum about the centre of the foot, so as to form a kind of groove for it. The muscle is bifurcated behind, and the heads of origin are separated by the long plantar ligament. On it are the external plantar vessels and nerve, and the flexor brevis digitorum conceals it.

is joined with flexor longus.

Insertion of tendon of flexor pollicis.

The tendon of the FLEXOR LONGUS POLLICIS in the sole of the foot is deeper than that of the flexor longus digitorum, to which it is united by a strong tendinous process: it is then directed to the root of the great toe, enters the digital sheath, and is *inserted* into the base of the ungual phalanx. Between the calcaneum and the internal malleolus this tendon lies in a groove in the astragalus, and then in one below the tubercle (sustentaculum tali) of the os calcis.

Dissect third layer of muscles.

Dissection. — For the dissection of the third layer of muscles, the accessorius and the tendons of the long flexor are to be cut through near the calcaneum, and turned towards the toes, but without injuring the external plantar nerve and artery, or small filaments of nerves to the two external lumbricales. Afterwards the cellular membrane is to be taken from the muscles now brought into view.

Third layer of muscles.

Third layer of muscles. — Only the short muscles of the great and little toe enter into this layer. On the metatarsal bone of the great toe the flexor brevis pollicis lies, and external to it is the adductor pollicis, whilst on the metatarsal bone of the little toe is the flexor brevis minimi digiti.

Position.

Crossing the heads of the metatarsal bones is the transversalis pedis muscle. The fleshy mass between the adductor pollicis and the short flexor of the little toe consists of the interossei muscles of the next layer.

Flexor brevis pollicis is bifurcated before

The FLEXOR BREVIS POLLICIS muscle is tendinous and pointed at the posterior part, but bifurcated in front. It is attached posteriorly to the cuboid bone, and to a prolonga-

tion of the tendon of the tibialis posticus to the external cuneiform bone; near the front of the metatarsal bone of the great toe it divides into two heads, which are inserted into the sides of the base of the metatarsal phalanx. Resting on the muscle, and in the interval between the heads, is the tendon of the flexor longus pollicis. The inner head joins the abductor, and the outer is united with the adductor pollicis of the same toe. A sesamoid bone is developed in the tendon connected with each head. and joins other muscles.

The ADDUCTOR POLLICIS, which is larger than the preceding muscle, and external to it, arises from the sheath of the tendon of the peroneus longus, and from the base of the third and fourth metatarsal bones. Anteriorly the muscle is united with the outer head of the short flexor, and is inserted with it into the base of the metatarsal phalanx of the great toe. To the inner side is the flexor brevis, and beneath the outer border the external plantar artery and nerve are directed inwards. Adductor pollicis joins outer head of short flexor. Covers plantar arch.

The FLEXOR BREVIS MINIMI DIGITI is a small narrow muscle, which lies on the metatarsal bone of the little toe, and resembles one of the interossei. Attached to the metatarsal bone, and slightly to the sheath of the peroneus longus, it is *inserted* into the outer side of the base of the metatarsal phalanx of the same toe. Flexor minimi digiti is like an interosseous.

The TRANSVERSALIS PEDIS is placed transversely over the heads of the metatarsal bones. Its origin is by fleshy bundles from the four outer bones, and its insertion is united with that of the adductor pollicis. The cutaneous surface is covered by the tendons, and the vessels and nerves of the toes; and the opposite surface is in contact with the interossei muscles. Transversalis pedis attached to ends of the toes.

Dissection. — In order that the deep vessels and nerves may be seen, the flexor brevis and adductor pollicis are to be cut through at their posterior part, and thrown towards the toes, but the nerves that supply them are to be preserved. Beneath the adductor is the plantar arch, with the external plantar nerve, which, with their branches, together with the part of the dorsal artery of the foot that enters the sole by the first interosseous space, should next be cleaned. The flexor brevis minimi digiti may be detached and Dissect the deep vessels and nerves.

thrown forwards. The muscles projecting between the metatarsal bones are the interossei.

Arch of the plantar artery.

The *plantar arch* is the part of the external plantar artery that extends obliquely forwards from the base of the metatarsal bone of the little toe to the posterior part of the first interosseous space. It is placed across the tarsal ends of the metatarsal bones in contact with the interossei, or between the third and fourth layers of muscles in the foot. Internally the arch is completed by a communicating branch from the dorsal artery of the foot. From the front or convexity of the arch the digital branches are supplied, and from the opposite side small muscular branches arise. From the under part are given off three small arteries (*posterior perforating*), which pass to the dorsum of the foot through the three outer interosseous spaces, and anastomose with the interosseous branches of the anterior tibial artery.

Extent and connections with muscles.

Branches.

Posterior perforating.

Digital branches to three outer toes and half the next.

The *digital branches* are four in number, and supply both sides of the three outer toes, and half the next. The one to the outer side of the little toe is single; the others lie in the three outer interosseous spaces, and bifurcate in front to supply the contiguous sides of two toes. Where they divide they send small communicating branches (*anterior perforating*) to the interosseous arteries on the dorsum of the foot. On the sides of the toes the disposition of the arteries is the same as in the hand: they extend to the last phalanx, where they unite in an arch, from which offsets are given to the ball of the toe; and they further form anastomotic loops beneath the tendons, near the front of both the metatarsal and the next phalanx, which supply the phalangeal articulations.

Anterior perforating offsets.

Distribution.

Ending of the dorsal artery of the foot;

The *dorsal artery of the foot* enters the sole at the posterior part of the first interosseous space, and supplies digital offsets to both sides of the great toe and to half the next, in the same manner as the radial artery in the hand is distributed to one digit and a half. Besides these it furnishes a communicating branch to join the plantar arch.

its digital branch.

The *digital branch* (art. magna pollicis) extends to the front of the first interosseous space, and divides into collateral branches for the great toe and the next. Near the front of the metatarsal bone it sends inwards, beneath the flexor muscles, the digital branch fo

the inner side of the great toe. These arteries have the same arrangement along the toes as the rest.

The *deep branch* of the *external plantar nerve* passes with the arch of the artery, and ends internally in branches to the adductor pollicis. Moreover, it furnishes branches to all the interossei, one or both in the external space excepted; to the transversalis pedis; and to the two external lumbrical muscles. External plantar nerve ends in the deep muscles.

Dissection. — Remove the transversalis pedis muscle to expose a ligamentous band that is placed across the heads of the metatarsal bones. Dissection.

The *transverse metatarsal ligament* is a strong fibrous band that connects together the anterior extremities of all the metatarsal bones, and resembles a similar structure in the hand. To its hinder part is connected a thin fascia that covers the interossei muscles. It is concealed by the transversalis pedis, and by the tendons, vessels, and nerves of the toes. Transverse metatarsal ligament

Dissection. — To complete the dissection of the last layer of muscles, divide the metatarsal ligament between the bones, and carry the knife directly backwards in the centre of the interosseous spaces except the first, in order to separate the two interossei muscles one from another. Take away the fascia covering these muscles, and follow the branches of the external plantar nerve to them. All the interossei are visible in the dissection of the sole of the foot. Dissect the last layer of the muscles.

Fourth layer of muscles. — In the fourth and last layer of the foot are contained the interossei muscles, and the tendons of the tibialis posticus and peroneus longus muscles. Fourth layer of muscles.

The INTEROSSEI MUSCLES are situate in the intervals between the metatarsal bones. Their anatomy corresponds closely to that of the interossei in the hand, and like them they are arranged in two sets, plantar and dorsal. They are seven in number, three plantar and four dorsal; and two are found in each space, except in the most internal one. Interossei, are plantar and dorsal.

The *plantar interossei* arise from the three outer metatarsal bones, their under and inner surfaces, and are inserted into the tibial side of the base of the metatarsal phalanx of Three plantar for three outer toes.

the same toes. An expansion is continued from each to the extensor tendon on the dorsum of the phalanx. These muscles are smaller than the dorsal, and are placed more in the sole of the foot.

Four dorsal lie between the bones;

The *dorsal interossei*, one in each space, arise by two parts from the lateral surfaces of the bones between which they lie, and are inserted into the side of the metatarsal phalanx of certain toes. Thus, the two internal muscles go to the second toe, one to each side, the next to the outer side of the third toe, and the remaining one to the outer side of the fourth toe. An expansion is continued from their tendons to the extensor tendons on the dorsum of the phalanges. The posterior perforating arteries pierce the hinder extremities of this set of muscles. These small muscles will be partly seen on the dorsum of the foot.

toes inserted into.

Trace out the deep tendons.

Dissection.—Follow the tendon of the tibialis posticus muscle from its position behind the inner malleolus to its insertion into the scaphoid bone, and trace the processes that it sends forwards and outwards. Open also the fibrous sheath of the tendon of the peroneus longus, which crosses from the outer to the inner side of the foot.

Insertion of tendon of tibialis posticus.

The tendon of the TIBIALIS POSTICUS, after leaving the groove in the inner malleolus, is continued forwards over the internal lateral ligament of the ankle-joint, and beneath the articulation between the astragalus and os scaphoides, to be inserted into the prominence of the latter bone. From its insertion three or four processes are continued to other bones. One passes to the internal, and another to the external cuneiform bone; and a third is directed backwards to the margin of the groove in the os calcis for the tendon of the flexor longus pollicis. Where the tendon is placed beneath the articulation of the astragalus, it often contains a sesamoid bone.

Insertion of tendon of peroneus longus.

The tendon of the PERONEUS LONGUS MUSCLE turns round the cuboid bone, and placed in the groove on the under surface is continued inwards to be inserted into the outer side of the base of the metatarsal bone of the great toe. The tendon is contained in a fibrous sheath, formed

for the most part by fibres of the long plantar ligament, which pass from the ridge on the cuboid bone to the tarsal ends of the third and fourth metatarsal bones. A synovial membrane lubricates the sheath.

SECTION VI.

THE FRONT OF THE LEG.

Position. — The limb is to be raised to a convenient height by blocks placed beneath the knee, and the foot is to be extended in order that the muscles on the front of the leg may be put on the stretch. Position of the limb.

Dissection. — To enable the dissector to raise the skin from the leg and foot, make one incision along the middle line from the knee to the toes, and intersect it by cross cuts at the ankle and at the web of the foot. Raise the skin.

After the skin is raised from the leg and foot, the cutaneous vessels and nerves should be looked for. At the inner part of the leg are some filaments from the great saphenous nerve, and at the outer side others from the cutaneous ramifications of the external popliteal nerve. Perforating the fascia in the lower third, and on the anterior aspect, is the musculo-cutaneous nerve, whose branches should be traced to the toes. On the dorsum of the foot is an arch of veins, which ends at the sides in the saphenous veins; on the outer side is the short saphenous nerve, and in the interval, between the great toe and the next, is the cutaneous part of the anterior tibial nerve. Remove next the integuments from the toes. After the several vessels and nerves are dissected, the fat is to be taken away, in order that the fascia may be seen. Seek the cutaneous nerves in the leg; on the foot both vessels and nerves.

The *venous arch on the dorsum of the foot* has its convexity turned forwards, and receives digital branches from the toes; but at the opposite side it is joined by small veins from the instep. Internally and externally it ends in the saphenous veins. Cutaneous veins.

The internal saphenous vein begins at the inner side of the great toe, and in the arch of veins; it ascends along the inner side of the foot, and in front of the inner ankle to the Internal saphenous.

inner part of the leg, where it has been before seen. It receives branches from the inner side and sole of the foot.

External saphenous. The *external saphenous vein* begins on the outside of the little toe and foot, and in the venous arch: it is then continued below the outer ankle to the back of the leg.

Source of the cutaneous nerves. CUTANEOUS NERVES. All the superficial nerves on the front of the leg and foot are derived from branches of the popliteal trunks, viz., from the musculo-cutaneous and anterior tibial nerves of the external popliteal, and from the external saphenous nerve of the internal popliteal. Some inconsiderable offsets to the sides of the leg from the internal and external saphenous do not require separate notice.

Musculo-cutaneous supplies certain toes; The *musculo-cutaneous nerve* has a cutaneous termination, and its destination is to the dorsum of the foot and toes. Perforating the fascia in the lower third of the leg, it divides into two principal branches (inner and outer), which give digital nerves to the sides of all the toes, except the outer part of the little toe, and the contiguous sides of the great toe and the next. The digital branches may be traced in the integument as far as the end of the last phalanx.

divides into inner and *a.* The *inner branch* communicates with the internal saphenous nerve, and supplies the inner side of the foot and great toe: it also joins the anterior tibial nerve.

outer branch. *b.* The *outer branch* divides into three nerves, which lie over the three outer interosseous spaces, and bifurcate at the web of the foot for the supply of the contiguous sides of the four toes corresponding to those spaces: it joins the external saphenous nerve on the outer part of the foot.

Anterior tibial, where found. The *anterior tibial nerve* becomes cutaneous in the first interosseous space, and is distributed to the opposed sides of the great toe and the next. The musculo-cutaneous nerve joins it, and sometimes assists in supplying the same toes.

External saphenous. The *external saphenous nerve* comes from the back of the leg below the outer ankle, and is continued along the foot to the outside of the little toe. Occasionally it supplies both sides of the little toe, and part or more of the next.

Deep fascia of the leg; attachments; The *fascia of the front of the leg* is thickest at the upper part where it gives origin to muscles. It is fixed internally and externally to the tibia and fibula. Intermuscular septa are prolonged from the deep surface, and one of these that is

attached to the fibula, separates the muscles on the front from those on the outer side of the leg. Superiorly the fascia is connected to the heads of the bones, but inferiorly it is continued to the dorsum of the foot. Above and below the ankle-joint are some strong transverse fibres, marking the position of the two parts of the anterior annular ligament; and below the end of the fibula is another band, the external annular ligament. Transverse fibres at the ankle.

Dissection. — The fascia is to be removed from the leg, and from the dorsum of the foot, without cutting away the thickened band of the annular ligament above and below the end of the tibia. On separating the fascia from the anterior muscles, let the edge of the scalpel be directed upwards. Take away the fascia from the peronei muscles on the outside of the fibula, but leave the band below that bone. On the dorsum of the foot the short extensor of the toes is to be made clean. Take away the fascia.

The *anterior annular ligament* consists of two parts, upper and lower, which confine the muscles in their position; the former serving to bind their vertical part to the bones of the leg, and the latter to keep down the tendons on the dorsum of the foot. Anterior annular ligament;

The *upper part* is attached laterally to the bones of the leg, and is divided into two sheaths, one for the tibialis anticus, and the other for the extensor longus digitorum. its upper

The *lower part* is in front of the tarsal bones; it is inserted externally into the upper surface of the os calcis, in front of the depression for the interosseous ligament, and, internally, by a thin and widened piece into the plantar fascia and the inner malleolus. In this part of the ligament there are three sheaths: first, on the inner side, is one for the tibialis anticus; next, one for the extensor pollicis; and, lastly, another for the extensor longus digitorum. Separate synovial membranes lubricate the sheaths. and lower part. Sheaths differ in each.

The *external annular ligament* is attached on the one side to the outer malleolus, and on the other to the outer part of the os calcis; it contains the tendons of the peronei muscles in one sheath, which is lined by synovial membrane. External annular ligament.

The *muscles on the fore part of the leg* are the following: — Next the tibia is the tibialis anticus; next the fibula the Muscles on the front of

the leg and foot. extensor longus digitorum, its lower part with a separate tendon to the fifth metatarsal bone, being called peroneus tertius; and between these, in the lower half of the leg, is the extensor pollicis. On the dorsum of the foot is one muscle, the extensor brevis digitorum.

Tibialis anticus; The TIBIALIS ANTICUS is thick and fleshy in the upper part, but tendinous in the lower part of the leg. It *arises* origin, from the outer tuberosity and two upper thirds of the tibia, from the contiguous part of the interosseous ligament, and from the fascia of the leg, and the intermuscular septum between it and the next muscle. After passing through the innermost compartment in the annular ligament, the tendon insertion. is *inserted* into the under surface of the internal cuneiform bone, and into the metatarsal bone of the great toe, to which a process is continued. The muscle is subfascial: it is at first Parts beneath the muscle, and on the sides. external to the tibia, resting on the interosseous membrane, but it is then placed successively over the end of the tibia, the ankle-joint, and the inner line of the tarsal bones. The outer border touches the extensor muscles of the toes, and partly conceals the anterior tibial vessels as low as the foot.

Extensor pollicis The EXTENSOR PROPRIUS POLLICIS is deeply placed at its origin, between the former muscle and the extensor longus digitorum, but its tendon becomes superficial on the dorsum of the foot. The muscle *arises* from the middle part of the attached to fibula, inner surface of the fibula, and from the interosseous ligament near it: the tendon comes to the surface through a sheath in the lower part of the annular ligament, and then continues over the inner part of the tarsus to be *inserted* and great toe, crosses the vessels. into the last phalanx of the great toe. The anterior tibial vessels are to the inner side of the muscle as low as the sheath in the ligament, but afterwards to the outer side of the tendon, so that they cross it beneath the ligament.

Extensor longus arises from tibia; The EXTENSOR LONGUS DIGITORUM, like the tibial muscle, is fleshy in the leg and tendinous on the foot. Its *origin* is from the tuberosity of the tibia (the outer part), from the head and three fourths of the inner surface of the fibula, from the contiguous interosseous membrane, and from the fascia of the leg and the intermuscular septum on each side. inserted The tendon enters its sheath in the annular ligament with

the peroneus tertius, and divides into four pieces. Below the ligament these tendons are continued to the four outer toes, and are *inserted* by processes into the middle and ungual phalanges. into four outer toes.

On the phalanges of the toes the tendons have the same arrangement as in the hand; for on the metatarsal phalanx the tendons of the long and short extensor join with prolongations from the interossei and lumbricales to form a membranous expansion. At the further end of this phalanx the expansion divides into three parts — a central and two lateral; the central piece is inserted into the base of the middle phalanx, while the lateral ones unite at the front, and are fixed into the ungual phalanx. Arrangement of the tendons on the toes.

In the leg the muscle is placed between the peroneus on the one side, and the tibialis anticus and extensor proprius pollicis on the other; it lies on the fibula, on the lower end of the tibia, and on the interosseous membrane and the ankle-joint. On the foot the tendons rest on the extensor brevis digitorum, and the vessels and nerve of this part are internal to them. Connections of the muscle.

The *peroneus tertius* is but a part of the extensor longus digitorum, from which it is seldom separate. Arising from the lower fourth of the inner surface of the fibula, and from the intermuscular septum between the extensor and the peronei muscles, it is *inserted* by a tendon into the tarsal end of the metatarsal bone of the little toe. This muscle has the same connections as the lower part of the long extensor, and is contained in the same space in the annular ligament. Peroneus tertius is the lower part of the extensor.

The ANTERIOR TIBIAL ARTERY extends from the bifurcation of the popliteal trunk to the front of the ankle-joint, where it becomes the dorsal artery of the foot. The course of the artery is at first forwards, through the aperture in the upper part of the interosseous membrane, and then along the front of that membrane and the tibia to the foot. A line from the inner side of the head of the fibula to the centre of the ankle will mark the position of the vessel. Anterior tibial artery; course and extent;

In the upper third of the leg the artery lies between the tibialis anticus and the extensor longus digitorum, and in connections with

parts around. the lower two thirds between the tibial muscle and the extensor proprius pollicis, but the last muscle becomes superficial to the lower end of the vessel, and crosses to the inner side of it. The artery rests on the interosseous membrane in two thirds of its extent, and is overlapped by the fleshy bellies of the contiguous muscles, so that it is at a great depth from the surface; but in the lower third it is in front of the tibia and ankle-joint, and is comparatively superficial, for it here lies between only the tendons of the muscles. Position of veins Venæ comites closely entwine around the artery, covering it with cross branches on the upper part. and nerve; The anterior tibial nerve approaches the tibial vessels about the middle third of the leg, and continues with them, crossing once or twice. At the lower end of the artery the nerve is on the outer side.

branches. *Branches.*—In the leg the anterior tibial artery furnishes for the most part muscular offsets, but near the knee and ankle-joints other named branches take origin, and a cutaneous branch moreover accompanies the musculo-cutaneous nerve.

Recurrent. A *recurrent branch* leaves the trunk as soon as it appears above the interosseous membrane, and ascends in the tibialis anticus muscle to the knee-joint. On the joint it anastomoses with the other articular arteries.

Malleolar, inner and outer. *Malleolar arteries* (internal and external) arise near the ankle-joint, and, as their name expresses, are distributed over the ends of the tibia and fibula. The internal is the least regular in size and origin; the external anastomoses with the anterior peroneal artery.

Articular. Some small *articular arteries* are supplied from the lower end of the artery to the ankle-joint.

Dorsal artery; extent and course; The DORSAL ARTERY of the foot is the continuation of the anterior tibial, and extends from the front of the ankle-joint to the posterior part of the first interosseous space, where it passes downwards between the heads of the interosseous muscle, to end in the sole as before described (p. 676.).

connections. The artery is supported by the inner row of the tarsus and their articulations, viz., the astragalus and the scaphoid

and cuneiform bones; and is covered here by the integuments and the deep fascia, but near its termination it is crossed by the inner tendon of the extensor brevis muscle. The tendon of the extensor pollicis is on the inner side, and that of the extensor brevis digitorum on the outer side except for about half an inch before the artery dips into the sole of the foot, at which spot the tendon of the latter muscle then crosses to the inner side of the vessel. The veins have the same position with respect to the artery as in the leg, and the nerve is external to it. Position of veins and nerve.

Branches.—Offsets are given to the bones and the ligaments of the foot: those from the outer side of the vessel have received the names tarsal and metatarsal from their destination. A small interosseous branch is likewise furnished to the first interosseous space. Branches.

The *tarsal branch* arises opposite the scaphoid bone, and runs beneath the extensor brevis digitorum to the outer side of the foot, where it divides into twigs that inosculate with the metatarsal, plantar, and peroneal arteries: it supplies offsets to the extensor muscle, beneath which it lies. Tarsal.

The *metatarsal branch* takes an arched course to the outer part of the foot near the base of the metatarsal bones, and beneath the extensor muscle, and its terminal branches anastomose with the external plantar and tarsal arteries. Metatarsal,

From the convexity of this arch, which is turned forwards, three interosseous arteries are furnished to the three outer spaces: these supply the interosseous muscles, and divide at the cleft of the toes into two dorsal collateral branches. At the fore part and back of each space the interosseous arteries receive the anterior and posterior perforating branches from the plantar arch and digital arteries in the sole of the foot. which gives interosseous.

The *first interosseous branch* (arteria dorsalis pollicis pedis) arises from the trunk of the artery as it is about to leave the dorsum of the foot; it extends forwards in the space between the first two toes, and is distributed like the other interosseous branches of the metatarsal artery. First interosseous.

The *anterior tibial veins* have the same extent and connections as the artery they accompany. They have their usual position along the artery, one on each side, around which they form loops by cross branches, and end in the Anterior tibial veins.

popliteal vein; they receive branches corresponding to those of the artery, and communicate with the internal saphenous vein.

Varieties in anterior tibial

Peculiarities in the vessels. The anterior tibial may be small, or even wanting, in which case the place of its diminished or deficient part will be supplied by the posterior tibial or the peroneal artery. On the dorsum of the foot it is often removed farther outwards than the direction of a line from the centre of the ankle to the posterior part of the first inter-

and dorsal artery.

osseous space. The place of the dorsal artery of the foot may be taken by a large anterior peroneal artery.

Divide extensor longus.

Dissection. — To examine the extensor brevis digitorum on the dorsum of the foot, cut through the tendons of the extensor longus and peroneus tertius below the annular ligament, and throw them towards the toes. Dissect out the attachment of the muscle to the os calcis.

Extensor brevis

The EXTENSOR BREVIS DIGITORUM is a short thin muscle on the dorsum of the foot. Arising from the outer surface of the os calcis in front of the groove for the peroneus brevis muscle, and from the anterior annular ligament (the

sends tendons to four inner toes;

lower band), the muscle ends in four tendons, which spring from as many fleshy bellies, and are *inserted* into the four inner toes. The tendon to the great toe has a distinct attachment to the base of the metatarsal phalanx, but the rest are united to the outer side of the tendons of the long extensor, and assist to form the expansion on the metatarsal

insertion of these.

phalanx (p. 683.). The muscle lies on the tarsus, and is partly concealed by the tendons of the long extensor. Its inner tendon crosses the dorsal artery of the foot.

Cut through extensor brevis.

Dissection. — Divide the extensor brevis near its front, and turn it upwards with care so as to avoid injuring the branches of artery and nerve that are beneath it. The lower band of the annular ligament is to be cut through over the tendon of the extensor pollicis, and the external half of it to be thrown outwards. Examine next the different sheaths of the ligament, the attachment of it to the os calcis, and the origin of the extensor brevis digitorum from

Follow up the nerves.

it. Follow upwards the anterior tibial and musculo-cutaneous nerves to their origin from the external popliteal, and trace a small branch from the same nerve through the tibialis anticus to the knee-joint.

Nerves to the front of the leg. — Between the fibula and the peroneus longus muscle the external popliteal nerve divides into the recurrent articular, musculo-cutaneous, and anterior tibial branches. Nerves of the front of the leg.

The *recurrent articular branch* is very small, and takes the course of the artery of the same name through the tibialis anticus muscle to the knee-joint. Recurrent.

The *musculo-cutaneous nerve* is beneath the fascia in the first part of its course, and is continued between the extensor longus digitorum and peronei muscles to the lower third of the leg, where it pierces the fascia, and is distributed to the dorsum of the foot and the toes (p. 680.). Before the nerve becomes cutaneous, it furnishes branches to the peronei muscles. Musculo-cutaneous supplies peronei.

The *anterior tibial nerve* (interosseous) is directed inwards beneath the extensor longus digitorum, and reaches the artery of the same name about the middle of the leg. From this spot it takes the course of the vessel along the foot to the first interosseous space, in which it ends on the surface (see p. 680.). Its position is external to the dorsal artery of the foot, but in the leg it crosses the anterior tibial artery once or more. Anterior tibial is with the artery.

In the leg the nerve supplies the anterior tibial muscle and the extensor of the toes. On the dorsum of the foot it gives a large branch to the short extensor, which increases and gives offsets to the articulations of the foot. Branches.

Muscles on the outer part of the leg. — Only two muscles are found in this situation: they are named peronei from their attachment to the fibula, and are distinguished by terms expressive of their relative length (longus and brevis). Intermuscular processes of fascia, which are attached to the fibula, isolate these two muscles from others, viz. from the soleus and flexor pollicis behind, and from the extensor longus digitorum in front. External muscles of the leg.

The PERONEUS LONGUS is the more superficial of the two muscles, and arises from the head of the fibula, from the upper half of the outer surface of the shaft of this bone, and from the fascia and intermuscular septa. Inferiorly it ends Peroneus longus. Origin from the fibula;

in a tendon which is contained with that of the peroneus brevis in the groove at the back of the external malleolus, and in the sheath of the external annular ligament. Afterwards the tendon is continued in a separate sheath, below that of the peroneus brevis, along the side of the os calcis to the groove in the outer border of the cuboid bone, by which it enters the sole of the foot. Its position in the foot, and insertion into the metatarsal bone of the great toe, are described in page 678. In the leg the muscle is immediately beneath the fascia, and lies on the peroneus brevis. Beneath the annular ligament it is on the middle part of the external lateral ligament of the ankle, with the next muscle, and surrounded by a single synovial membrane. The extensor longus digitorum and soleus muscles are fixed to the fibula laterally with respect to it, one being on each side.

insertion into great toe.

Position in the leg.

Peroneus brevis is attached to fibula

The PERONEUS BREVIS is smaller than the preceding muscle, and inferior to it in position. It arises from the lower half of the outer surface of the fibula, and from the intermuscular septa. With the tendon of the peroneus longus, it passes beneath the external annular ligament, and is placed next the fibula as it turns below that bone. Escaped from the ligament, its tendon enters a distinct fibrous sheath, which conducts it along the tarsus to its *insertion* into the base of the metatarsal bone of the little toe. In the leg the muscle is beneath the peroneus longus. On the outer side of the foot it is contained in a sheath above the tendon of the former muscle, and each sheath is lined by a prolongation from the synovial membrane behind the outer ankle.

and bone of the little toe;

connections.

SECTION VII.

LIGAMENTS OF THE KNEE, ANKLE, AND FOOT.

Examine first the knee-joint.

THE student may now examine the remaining articulations of the limb, and may take first the knee-joint, unless this has become somewhat dry, in which case the ankle-joint and the ligaments of the foot may be dissected whilst the other is being moistened.

Dissection.—In the dissection of the ligaments of the articulations, it is necessary to detach the muscles and tendons from the particular joint, and to remove the cellular or fibrous structure that may obscure or conceal the ligamentous bands. In the knee-joint a kind of capsule is to be defined around the articular surfaces of the bones; and there are four other ligaments, anterior and posterior, internal and external, which will be found as thickened bands at their respective parts of the articulation. Some tendons, namely, those of the biceps, popliteus, adductor magnus, and semimembranosus, are to be followed to their insertion, so that a part of each sufficient for the purpose should be left.

Dissection to see a capsule and the external ligaments.

The ARTICULATION OF THE KNEE. — The knee is the largest hinge joint in the body, and is formed by the contiguous ends of the tibia and femur with the patella. The articular surfaces of the bones are covered with cartilage, and lubricated by synovial membrane, and are maintained in apposition by the following ligaments: —

Bones in the knee-joint.

A kind of *capsule* surrounds the ends of the bones, and fills the intervals between the stronger special ligaments. In front it receives accessory fibres from the vasti and crureus, and from the biceps and sartorius; and, behind, from the tendon of the semimembranosus. It is connected, as will be afterwards seen, with the interarticular cartilages, and the tendon of the popliteus muscle perforates it.

Capsule only an imperfect covering.

The *external lateral ligament* is round and cord-like; it is attached to the outer condyle of the femur below the tendon of the gastrocnemius, and descends vertically between two pieces of the tendon of the biceps to the outer part of the head of the fibula. A second fasciculus, *short external lateral* ligament is sometimes found behind the other. Beneath the ligament are the tendon of the popliteus and the upper external articular vessels and nerve.

External lateral ligament is small.

The *tendon* of the *biceps* is inserted into the upper part of the head of the fibula by two processes, and from one of these there is a prolongation to the head of the tibia. The external lateral ligament passes between the pieces into which the tendon splits.

Tendon of the biceps is divided.

The *tendon* of the *popliteus* may be followed to the femur by dividing the external lateral and capsular ligaments. It

Tendon of the popliteus

is attached to outer condyle, arises from the fore part of the depression on the outer surface of the external condyle of the femur, and in its course to the outside of the joint crosses the external semilunar cartilage and the upper tibio-peroneal articulation. When the joint is bent, the tendon lies in the hollow on the condyle.

Adductor magnus to the inner. The *tendon* of the *adductor magnus* is inserted into a tubercle on the inner surface of the internal condyle above the attachments of the gastrocnemius, and internal lateral ligament.

Internal lateral ligament; attachments; The *internal lateral ligament* is scarcely distinguishable from the capsule at its attachment to the condyle of the femur, but it becomes thicker inferiorly, and is fixed to the inner border and surface of the tibia as low as the popliteus muscle. The tendons of the sartorius, gracilis, and semitendinosus muscles lie over the ligament; and the tendon of the

is joined by semimembranosus. semimembranosus, and the lower internal articular vessels are beneath it: to the posterior edge some fibres of the tendon of the semimembranosus are added.

Insertion of the semimembranosus. The *tendon* of the *semimembranosus* muscle is to be followed beneath the internal lateral ligament. It is inserted beneath the ligament into the inner side of the tibia, and sends some fibres to that band; it gives also one membranous prolongation to join the fascia covering the popliteus muscle, and another to the posterior ligament of the knee-joint.

Posterior ligament. The *posterior ligament* (ligament of Winslow) is formed in great part of the fibres from the tendon of the semimembranosus, which are directed across the joint to the outer

Two sets of fibres. condyle, but a deeper set of fibres is continuous with the general capsule. Numerous apertures exist in it for the passage of vessels and nerves to the interior of the articulation.

Anterior ligament, or The *anterior ligament* (ligamentum patellæ) or the tendon of insertion of the extensor muscles of the leg, is about three inches long, and is narrower in the middle than at the ends.

tendon of the extensors. Superiorly, it is attached to the lower part of the patella and the depression on the inner surface; and, inferiorly, it is inserted into the tuberosity of the tibia. The expansion of the vasti covers it, and a bursa intervenes between it and the tibia (see p. 622.).

Dissection. — To see the reflections of the synovial membrane raise the knee on blocks, and open the joint by an incision on each side from the front to the back. When the anterior part of the capsule with the patella is thrown down, a fold (mucous ligament) is seen extending from the end of the femur to below the patella. On each side of the patella is a similar fold (alar ligament), containing some fat. The limb is afterwards to be taken from this position, and part of the posterior ligament is to be removed, to expose the crucial ligaments at the back of the joint; but the limb is to be replaced before these structures are learnt.

Open the knee joint, and dissect crucial ligaments.

The *synovial membrane* lines the interior of the capsule, and is continued uninterruptedly over the articular ends of the femur and tibia. It is likewise reflected over the strong crucial ligaments at the back of the joint. On the front of the femur the sac of the membrane extends two inches above the articular surface. Besides covering the head of the tibia, it invests both surfaces of two interarticular cartilages, and sends a pouch between the tendon of the popliteus and the external semilunar cartilage and the head of the tibia. In the centre of the joint is a fold (mucous ligament) which contains a small vessel and some cellular tissue, and extends from the interval between the condyles to the fat below the patella. On each side of the patella is another fold (alar ligament), occasioned also by the fat at this spot, which is continuous with the former below the patella.

Synovial membrane extends above articular surfaces; is thrown into folds named mucous and alar ligaments.

Dissection.—With the limb still in the same position, detach the patella and its ligament, and clear away the fat that is behind it; but in doing this be careful of a small transverse band that connects anteriorly the interarticular cartilages. Take away the remains of the capsule and the synovial membrane from both the crucial ligaments and the interarticular cartilages.

Dissect semilunar cartilages.

Ligaments within the capsule. The remaining ligamentous structures, although within the capsule, are external to the sac of the synovial membrane which is reflected over them: they consist of the crucial ligaments in the middle line; of two flat plates of cartilage, the interarticular or semilunar, on the head of the tibia; and of the transverse ligament between the fore part of the last.

Other ligaments within the capsule.

The *crucial ligaments* are two strong fibrous processes, Two

crucial ligaments. which intervene between the ends of the tibia and femur, and chiefly maintain these bones in contact. They cross one another somewhat like the legs of the letter X, from which circumstance they have received their name. One is anterior to the other in position.

Anterior is oblique; its attachments; *a.* The *anterior* ligament is oblique in direction, and smaller than the posterior. Inferiorly it is attached to a depression in front of the spine of the tibia; and superiorly it is inserted into the inner surface of the outer condyle of the femur (its back part), and slightly into the interval between the condyles.

posterior is vertical. *b.* The *posterior* ligament is almost vertical between the bones at the back of the joint. By the lower end it is fixed to the depression behind the spine of the tibia, and by the upper it is inserted into the fore part of the hollow between the condyles of the femur, and into the contiguous surface of the inner condyle.

Their use in limiting the movements of the joint, The use of these ligaments in the movements of the joint, after the other ligaments are taken away, may now be studied. When the joint is much flexed, the anterior ligament is made tense, and the displacement of the femur from the tibia is prevented by it; but if the joint is forcibly extended, the posterior ligament is put on the stretch. Rotation inwards of the tibia is limited by the anterior ligament, but

and keeping the bones in contact. rotation outwards may be performed to such an extent as to allow the hinder part of that bone to be turned forwards. If the anterior ligament is divided, motion in either direction is equally free, and the femur can be readily displaced from the articular surface of the tibia.

Semilunar cartilages are two. The *interarticular* or *semilunar cartilages* are two fibro-cartilaginous plates which partly cover the articular surface of the tibia. They are thickest at the outer margin, where they are united by fibres to the capsule; and are hollowed on the upper surface, so as to assist in giving depth to the fossæ for the reception of the condyles of the femur. The synovial membrane covers both surfaces.

Internal is semicircular. *a.* The *internal* cartilage is semicircular in form, and is a segment of a larger circle than the external. In front it is attached by a pointed part to a tubercle anterior to the inner

articular surface of the tibia; and at the back, where it is much wider, it is fixed behind the spine of the tibia, between this process and the posterior crucial ligament.

b. The *external* cartilage is nearly circular in form, and is connected to the bone within the points of attachment of its fellow. Its anterior part is fixed to the depression in front of the spine of the tibia, where it is united with the anterior crucial ligament, and its posterior extremity is inserted into the middle of the spine of that bone. From the posterior part of this cartilage a ligamentous fasciculus ascends to the inner condyle of the femur, to be inserted before or behind the posterior crucial ligament. External, nearly circular in form, has a band of ligament.

The *transverse ligament* is a narrow band of fibres between the semilunar cartilages at the front of the joint. Sometimes it is scarcely perceptible. Transverse ligament.

Articular surface of the bones. The lower end of the femur presents on each side a large convex condyle, and between them a slightly hollowed part; of these two, the articular surface on the external condyle is the largest and extends highest. On the head of the tibia are two articular surfaces, but the inner one has the greatest extent. The surface of the patella is divided into two parts, but unequally, by a vertical ridge, so that the outer, which corresponds to the wider face on the external condyle of the femur, is the largest in size. Articular end of the femur, tibia, and patella.

Peroneo-tibial articulations. — The tibia and fibula are united by ligamentous bands at the ends where they touch, and by an interosseous ligament between the shafts of the bones. The surfaces in contact are tipped with cartilage and covered by a synovial membrane. Articulation of tibia and fibula.

Dissection. — The muscles are to be removed from the front and back of the interosseous ligament, and the cellular membrane is to be taken from a small band in front of, and behind both the upper and lower articulations between the tibia and fibula. A strong interosseous ligament at the lower part of the bones can be seen only by tearing the bones away from one another after the examination of the ankle-joint. Dissection of the ligaments.

a. The *upper articulation*, like the lower, is immoveable, Upper

articulation, and therefore the structures between the ends of the bones are simple. Only two small bands, anterior and posterior, are present here.

by anterior The *anterior ligament* extends before the joint from the outer tuberosity of the tibia, to the head of the fibula. The

and posterior band. *posterior* ligament, thinner than the anterior, is attached to corresponding parts of the bones behind the joint, and is covered by the tendon of the popliteus muscle. A *synovial membrane* lines the articular surfaces of the bones, and projects upwards so as to touch that of the knee-joint.

Lower articulation has *b.* The *lower articulation* is continuous with the ankle-joint, for the same synovial membrane serves the two. Besides an anterior and a posterior band, there is an inferior ligament between the lower ends of the bones.

anterior The *anterior ligament* reaches obliquely from the lower

posterior end of the tibia to the fibula, and the *posterior* has attachments behind the joint, similar to those of the band in front.

and inferior ligament. The *inferior* ligament is continuous with the fibres of the posterior, but is stronger than it. It is fixed on the one side to the end of the fibula, and on the other along the posterior edge of the articular surface of the tibia, so as to assist in deepening this hollow.

Interosseous ligament between the bones, The *interosseous ligament* is an aponeurotic partition between the muscles on the front and back of the leg. Its fibres are for the most part directed downwards from the outer border of the tibia to the ridge on the inner surface of the fibula; but some few cross in the opposite direction. Both superiorly and inferiorly is an aperture which transmits vessels, viz. the anterior tibial at the one spot, and the anterior peroneal at the other. Some strong irregular bundles

inferior ligament. of fibres, which constitute the *inferior* interosseous ligament, extend between the bones below the aperture for the anterior peroneal artery; these take different directions like the fibres of the rest of the interosseous membrane.

Bones of the ankle-joint. Articulation of the Ankle.—Like the knee, the ankle is a ginglymoid or hinge joint. In this instance the upper surface of the astragalus is received into an arch formed by the lower ends of the tibia and fibula, and the four ligaments

belonging to this kind of articulation connect together the bones.

Dissection. — To make the dissection required for the ligaments of the ankle-joint, remove the cellular membrane and vessels from the front and back of that articulation. For the purpose of defining the lateral ligaments, the limb must be placed first on one side and then on the other: the internal ligament is wide and strong, and is beneath the tendon of the tibialis posticus; the external is divided into three separate pieces, and to find these the peronei muscles and the remains of the annular ligament below the outer malleolus should be taken away. Dissection of the ankle-joint.

The *anterior* or tibio-tarsal *ligament* is a thin fibrous membrane, which is attached to the tibia near the articular surface, and to the upper part of the astragalus near the articulation with the scaphoid bone. The ligament is not usually a continuous membrane, for in it are some cellular intervals and apertures for vessels. On the sides it joins the lateral ligaments. Anterior ligament is thin and imperfect.

The *posterior ligament* is formed chiefly of transverse fibres, which seem to be continuous with the posterior piece of the external lateral ligament. It is inserted into the tibia and astragalus, close to the articular surfaces. Posterior ligament.

The *internal lateral* or deltoid *ligament* is attached by its upper or pointed part to the inner malleolus, and by its base to the astragalus, the os calcis, and the scaphoid bone. From its upper attachment the fibres radiate to their insertion below in this manner; the posterior are directed to the back part of the inner surface of the astragalus; the middle pass vertically to the side of the sustentaculum tali of the os calcis; and the anterior, which are thin and oblique, join the inferior calcaneo-scaphoid ligament, and the inner part of the scaphoid bone. The tendons of the tibialis posticus and flexor longus digitorum are in contact with this ligament. Internal or deltoid; attachments.

The *external lateral ligament* consists of three separate pieces, anterior, middle, and posterior: two of these (anterior and posterior) are attached to the astragalus, and the other to the os calcis. The *anterior* piece is a short flat band, which is directed from the fore part of the malleolus to the astragalus, in front of the lateral articular surface. The External has three parts: anterior,

middle, *middle* portion is round and cord-like, and descends from the tip of the malleolus to the os calcis at the middle of the outer and posterior. surface. The *posterior* part is the strongest, and is almost horizontal in direction; it is connected externally to the pit on the under surface of the malleolus, and is inserted into the posterior surface of the astragalus, extending to the groove for the flexor proprius pollicis tendon. The posterior and

Connections. middle fasciculi are in contact with the peronei muscles; but the middle part is altogether removed from the synovial membrane of the ankle-joint, and both it and the under surface of the posterior piece are in contact with the synovial membrane between the astragalus and os calcis.

Open the ankle-joint. *Dissection.*—Divide the ligaments of the ankle-joint, and separate the astragalus from the bones of the leg, to see the surfaces of the bones forming the joint.

Surfaces of the bones in the joint. *Articular surfaces.*—On the tibia there are two articular faces, one of which corresponds to the end of its shaft, and the other to the malleolus; but on the fibula only the surface of the malleolus that is turned to the astragalus is tipped with cartilage. The astragalus has a central articular surface that touches the end of the tibia, and on the sides are similar articular parts in contact with the malleoli, but the outer one is the largest.

Synovial sac. The *synovial membrane* of the joint lines the capsule, and is continued over the articular faces of the bones; a process of it is sent upwards to the lower peroneo-tibial articulation.

Articulations of the astragalus and os calcis. ARTICULATIONS OF THE ASTRAGALUS AND OS CALCIS.—These two chief bones of the tarsus are united to one another, as well as to the bones in front of them, by means of the undermentioned articulations.

Dissection for the joints of the tarsus. *Dissection.*—The articulations of the foot will be demonstrated by removing from both the dorsum and sole of the foot all the parts that have been already examined. Between the different tarsal bones bands of ligament extend, which will be defined by removing the cellular membrane from intervals between them.

Astragalus and scaphoid bone. *a. Articulation of the astragalus with the scaphoid bone.*—The large head of the astragalus is received into the hol-

low of the scaphoid bone, and is united to it only by a dorsal ligament, for the place of a plantar ligament is supplied by a strong band between the os calcis and the scaphoid bone, which will be afterwards seen.

The *dorsal* or *astragalo-scaphoid ligament* is attached to the astragalus close to the articular surface, and to the dorsal part of the scaphoid bone: its attachments will be better seen when it is cut through. The *synovial membrane* of the joint is the same as that between the astragalus and the anterior part of the os calcis. Dorsal ligament. Synovial membrane.

b. Articulation of the astragalus and os calcis.—These bones are kept together by a strong interosseous ligament, and there is also a thin band both on the outer side and behind. Astragalus and os calcis, by

The *posterior ligament* consists of a few fibres between the bones, where they are grooved by the tendon of the flexor pollicis; and the *external* ligament is connected to the sides of the astragalus and os calcis, near the middle piece of the external lateral ligament of the ankle-joint. The *interosseous ligament,* which will be brought into view by sawing off the part of the astragalus in front of it, and removing some fat, consists of strong vertical and oblique fibres, that are attached above and below to the depression on the contiguous surfaces of the two bones. This band extends across the bones, and its depth is greatest at the outer side. After the ligament is divided, and the astragalus removed, the bones will be seen to have *articular surfaces* where they touch, viz. behind the ligament, and in front of it. Two *synovial membranes* exist between the bones, one for each articular surface, and the one in front of the interosseous ligament is continued between the head of the astragalus and the scaphoid bone. posterior, external, and interosseous ligament. Articular surfaces and synovial membranes.

c. Articulation of the os calcis and scaphoid bone.—These bones are not in contact, but ligamentous bands extend between them both below, and on the outer side of the head of the astragalus, and thus make more perfect the socket for the reception of the fore part of this bone. Os calcis and scaphoid, by

The *inferior ligament* (calcaneo-scaphoid) will be better defined by removing some cartilaginous substance from it in inferior and

the sole of the foot; it is attached by one extremity to the anterior part of the os calcis, and by the other to a groove on the under surface of the scaphoid bone. The tendon of the tibialis posticus is beneath the ligament in the sole of the foot, and on it the head of the astragalus rests. The *external calcaneo-scaphoid* or interosseous ligament is outside the head of the astragalus, and is about half an inch deep; it is fixed to the os calcis, between the articular surfaces for the cuboid bone and the astragalus, and is attached in front to the outer side of the os scaphoides. These ligaments enter into the articulation of the astragalus with the scaphoid bone, and are lined by the same synovial membrane.

external ligaments that enter into astragalo-scaphoid articulation.

Os calcis and cuboid bone, by

d. Articulation of the os calcis with the cuboid bone.— The ligaments in this articulation are plantar and dorsal, and the former are much the strongest.

dorsal

The *dorsal ligament* (superior calcaneo-cuboid) is a thin fasciculus of fibres, which is attached to the upper surface of the contiguous ends of the os calcis and cuboid bone, and is divided into one or two parts. At the inner side of the os cuboides is another rather strong interosseous band from the os calcis. The *inferior calcaneo-cuboid ligament* in the sole of the foot is the strongest, and is divided into a superficial and a deep part:—The superficial portion (*ligamentum longum plantæ*) is attached to the under surface of the os calcis, and its fibres pass forwards to be connected to the ridge on the under part of the cuboid bone, while some are prolonged over the tendon of the peroneus longus muscle to the tarsal ends of the third and fourth metatarsal bones. The deep piece of the ligament will be seen, after the superficial is divided, to extend from the eminence on the fore part of the under surface of the os calcis, to the portion of the cuboid bone behind the ridge on it. A single *synovial membrane* is found between the bones.

and inferior ligament. The last is strongest, and divided into two parts.

Synovial sac.

Union of the scaphoid bone

ARTICULATIONS OF THE SCAPHOID BONE.—The scaphoid bone articulates in front with the three cuneiform bones, and laterally with the os cuboides, by dorsal and plantar bands.

to the cuneiform

a. In the *articulation* with the *cuneiform bones* there are three small *dorsal* ligaments, one to each bone, but the in-

nermost is the strongest. The place of *plantar* bands is supplied by processes of the tendon of the tibialis posticus. A *synovial membrane* lines the articulation, and sends forwards a prolongation between the cuneiform bones.

b. In the *articulation* with the *os cuboides* there is a *dorsal* band of fibres; a *plantar* band, which is concealed by the tendon of the tibialis posticus; and a strong *interosseous* ligament between the contiguous surfaces of the two. At the points of contact of the scaphoid and cuboid bones the surfaces are tipped with cartilage, and covered by a separate *synovial membrane.* and the cuboid bone.

ARTICULATIONS OF THE CUNEIFORM BONES.—These bones are united to one another by cross bands, and the external one also articulates with the os cuboides after a similar manner. Union of the cuneiform bones

a. The three *cuneiform bones* are connected together by short transverse *dorsal* bands between the upper surfaces. Similar *plantar* ligaments are wanting, except between the two innermost. There are also *interosseous* ligaments between the contiguous surfaces of the bones. one with another,

b. Where the *external cuneiform* touches the *cuboid bone* the surfaces are covered with cartilage, and furnished with a synovial membrane. A *dorsal* ligament passes transversely between the two, and a *plantar* ligament takes a similar direction. Between the bones there is also an *interosseous* ligament. and with the cuboid bone.

The *synovial membrane* of the articulation of the cuneiform bones is derived from that between the astragalus and the os scaphoides. Synovial sac.

ARTICULATIONS OF THE TARSAL AND METATARSAL BONES.—The last row of the tarsus articulates with the metatarsus in the following manner, namely, the three cuneiform with the three inner metatarsal, and the cuboid with the two outer metatarsal bones; but their line of union across the foot is very irregular. The bones are tipped with cartilage where they are in contact, and have, moreover, dorsal, plantar, and interosseous ligaments. Articulation of the tarsus and metatarsus.

Dorsal ligament.

a. The *dorsal ligaments* are thin bands of fibres, that are either longitudinal or oblique, as they extend from the tarsal to the metatarsal bones. Each metatarsal bone has the following number: — the first has one band from the inner cuneiform bone; the second has three bands, one from each cuneiform; the third has a ligament from the external cuneiform; and the third and fourth have a fasciculus to each from the os cuboides.

Plantar are longitudinal or oblique,

b. The *plantar ligaments* are mostly longitudinal; there is one from each of the cuneiform to the corresponding metatarsal bone, but between the cuboid and the remaining metatarsal bones there are only some scattered fibres. Oblique ligaments are also present in the sole of the foot: thus a superficial fasciculus of fibres extends from the front of the internal cuneiform to the second and third metatarsal bones, but a deeper and stronger ligament reaches from the same part to the inner side of the base of the second metatarsal; whilst from the external cuneiform there is a superficial band to the metatarsal bone of the little toe.

Longitudinal interosseous ligaments.

c. The *interosseous ligaments* are longitudinal, and limit the extent of the different synovial membranes. There is one on the outer side of the articulation between the third metatarsal and the external cuneiform bone, to both of which it is attached; and a second on the inner side of the articulation of the fourth metatarsal with the os cuboides.

Three synovial membranes.

The *synovial membranes* in the articulation are three in number, and will be seen by dividing the dorsal ligaments. There is one between the internal cuneiform and its metatarsal bone; a second for the cuboid and the two outer bones of the metatarsus; but the third, between the middle and external cuneiform and the corresponding (second and third) metatarsal bones, is an offset of the synovial membrane that belongs to the articulation of the astragalus and os scaphoides, which is prolonged between the two inner cuneiform bones.

Line of the articulation across the foot.

Line of the articulation. — In consequence of the unequal lengths of the cuneiform bones, the line of the articulation between the tarsus and metatarsus is zig-zag opposite them. To open the articulations the knife should be carried obliquely forwards from the tuberosity of the fifth to the base of the

second metatarsal bone, then about two lines further back for the union of the second metatarsal with the middle cuneiform, and, finally, half an inch in front of this for the joint of the internal cuneiform and the first metatarsal bone.

Dissection.—Let the cuneiform bones be forcibly separated from one another and from the cuboid, also the latter from the os scaphoides, to see the interosseous ligaments between them. The dissector will find the bones sometimes tear sooner than the ligaments give way. Afterwards the different structures are to be removed from the ligaments uniting together the metatarsal bones. Separate cunei-form and cuboid bones.

ARTICULATION OF THE METATARSAL BONES.—The tarsal ends of these bones are connected together by dorsal, plantar, and interosseous ligaments, and where the contiguous parts touch they are covered with cartilage. Union of the meta-tarsus, by

The *dorsal ligaments* are small transverse bands that pass from the base of one metatarsal bone to the next on the upper surface, except between the first two. The *plantar* ligaments are similar to the dorsal, but there is not any between the two inner bones. The *interosseous* ligaments are short, transverse fibres between the rough lateral surfaces of the four outer bones, and will be seen by tearing these asunder. The *synovial membrane* that covers the small lateral articular surfaces is derived in each instance from that which serves for the articulation of the metatarsus with the tarsus. dorsal, plantar, and inter-osseous liga-ments. Synovial sacs.

The digital ends of the metatarsus are further united by the *transverse metatarsal ligament*, which has been described in page 677. Anterior liga-ment.

ARTICULATION OF THE METATARSUS WITH THE PHALANGES.—These are ball and socket joints, in which the head of the metatarsal bone is received into the cup-shaped cavity of the phalanx. Union of meta-tarsus and pha-langes, by

Each articulation has two *lateral* and an *inferior ligament*, as in the hand, and the joint is further strengthened by an expansion derived from the tendon of the short extensor of the toes. A distinct *synovial membrane* exists in each. In two lateral and in-ferior liga-ments.

Synovial sac. the articulation of the great toe there are two sesamoid bones which are connected with the inferior and lateral ligaments.

See the hand. All these structures are better seen in the hand, where they are more distinct, and their anatomy may be learnt in the dissection of that part. See page 297.

Union of the phalanges same as before described in the hand. ARTICULATIONS OF THE PHALANGES. — There are two phalangeal joints to each toe, except in the first. The same ligaments are found in these as in the metatarso-phalangeal joints, viz., two *lateral* and an *inferior*. The joint between the two last phalanges is least distinct, and oftentimes the small bones are connected together by osseous material. These ligaments are noticed more fully in the dissection of the hand (p. 297.).

TABLE OF THE ARTERIES OF THE LOWER LIMB.

The Femoral Artery gives off

- External pudic
  - Superior
  - inferior.
- superficial epigastric
- superficial circumflex iliac.
- Profunda
  - External circumflex
    - Ascending
    - descending
    - transverse.
  - internal circumflex
    - Muscular
    - articular
    - ascending } final branches.
    - transverse } final branches.
  - first perforating
  - second perforating
    - nutritious.
  - third perforating
  - terminal branch.
- Muscular
- Anastomotic
  - Superficial
  - deep branch.
- Popliteal
  - Muscular
  - upper internal
  - upper external articular
  - lower internal
  - lower external articular
  - azygos articular
  - sural.
  - Anterior tibial
    - Recurrent
    - cutaneous
    - muscular
    - internal malleolar
    - external malleolar
    - articular
    - tarsal
    - metatarsal
      - three interosseous.
    - first interosseous communicating to deep arch
    - digital
      - To great toe and half the next.
  - Posterior tibial
    - peroneal
      - Muscular
      - nutritious to fibula
      - anterior peroneal.
    - nutritious to tibia
    - communicating to peroneal
    - articular
    - internal plantar
    - external plantar
      - Muscular
      - plantar arch
        - Muscular
        - posterior perforating
        - digital, for three toes and a half
        - anterior perforating.

* The branches of the internal iliac artery that are dissected in the limb, will be found in the table of the arteries of the abdomen.

TABLE OF THE VEINS OF THE LOWER LIMB.

The Femoral Vein, continued from the popliteal, receives

- Anastomotic -
  - Superficial
  - deep branch
- Muscular
- Profunda -
  - Terminal branch
  - first perforating
  - second perforating
  - third perforating
    - Nutritious.
  - External circumflex -
    - Ascending
    - transverse
    - descending.
  - Internal circumflex -
    - Muscular
    - articular.
- Internal saphenous -
  - Branch from dorsal arch of the foot
  - plantar
  - veins about os calcis
  - communicating with posterior and anterior tibial
  - communicating with deep veins of thigh
  - cutaneous from outer and inner parts of thigh
  - external pudic
  - superficial epigastric
  - superficial circumflex iliac.
- Popliteal -
  - Posterior tibial - -
    - external planiar
      - muscular
      - plantar arch -
        - Posterior perforating
        - digital from three toes and a half.
        - anterior perforating.
    - internal plantar
    - articular
    - communicating to saphenous
    - nutritious
    - peroneal - -
      - Anterior peroneal
      - muscular
      - nutritious.
  - Anterior tibial - -
    - communicating to deep arch
      - Digital from great toe and half the next.
    - interosseous
    - metatarsal - -
      - Three interosseous.
    - tarsal
    - malleolar
    - communicating to saphenous
    - muscular
    - recurrent
  - External saphenous -
    - Branch from dorsal arch of foot
    - plantar
    - veins from outer side of os calcis
    - cutaneous in the leg.
  - sural
  - articular
  - muscular

TABLE OF THE NERVES OF THE LOWER LIMB.

Nerves of the Lumbar Plexus in the Limb.

- 1. External cutaneous
  - Posterior and anterior branches.
- 2. Obturator
  - accessory
    - To obturator trunk
    - to pectineus
    - to hip-joint.
  - to obturator externus
  - to articulation
  - superficial division
    - Muscular
      - To gracilis
      - to adductor longus.
    - to plexus in the thigh
  - deep division
    - To adductor brevis and magnus
    - articular.
- 3. Anterior crural
  - Superficial portion
    - Muscular
      - To sartorius
      - to pectineus.
    - middle cutaneous
    - internal cutaneous
      - Anterior and inner branches.
  - deep part
    - Muscular
      - To rectus
      - to vastus externus - articular.
      - to vastus internus and crureus - articular.
    - internal saphenous
      - Branch to plexus over patella
      - to leg and foot.
- 4. Branch of genito-crural
  - To integuments.

Nerves of the Sacral Plexus in the Limb.

- 1. Small sciatic
  - Inferior gluteal
  - inferior pudendal
  - cutaneous to gluteal region, thigh, and leg.
- 2. Great sciatic
  - Articular to hip
  - to hamstrings.
  - external popliteal
    - Articular
    - cutaneous
    - peroneal communicating
    - recurrent articular
    - musculo cutaneous
      - To peronei
      - cutaneous to foot and toes.
    - anterior tibial
      - Muscular
      - articular
      - cutaneous to two toes.
  - internal popliteal
    - Articular
    - muscular
    - short saphenous.
    - posterior tibial
      - Muscular to flexors
      - internal plantar
        - Cutaneous of the sole
        - muscular
        - four digital
        - communicating branch
        - articular to the toes.
      - external plantar
        - Superficial part
          - Muscular
          - two digital
          - articular
        - deep part
          - Muscular
          - articular.
- 3. To quadratus and gemelli
  - articular.
- Superior gluteal
  - To glutei
  - to tensor vaginæ femoris.

CHAPTER X.

DISSECTION OF THE EYE.

Situation of the eyeball. THE eyeball is the organ of vision, and is lodged in the orbit; it is so placed that the axes of the two eyes are parallel in a state of rest, but not those of the eyeball and the containing cavity. In this hollow it is supported on a mass of fat, and is surrounded by muscles which impart to it its several movements. Two lids or shields protect the eyeball from external injury, and moderate the quantity of light admitted into the interior; and the anterior or exposed surface is covered by a mucous membrane (conjunctiva).

Parts around and in front of it.

The dissection to be made on the eyes of the ox. *Dissection.* — In the absence of specimens of the human eye, the structure must be learnt on that of some large animal, as the ox for example. Let the student, therefore, procure half a dozen or more eyes of the ox for the purpose of dissection. One or two small basins will be needed, and in the bottom of one of them, or of a deep plate, some melted wax or tallow should be run.

Detach the muscles. To see the general form of the ball of the eye, and the outer surface of the external coat, the attachment of the different muscles should be taken away, and the loose mucous membrane removed from around the anterior part.

Form of the ball. The ball of the eye is roundish in form, and presents on the exterior two parts which differ greatly in appearance, viz. an opaque posterior one, forming four-fifths of the whole, and a smaller transparent portion (cornea) in front; these two parts are segments of different-sized spheres, of which the anterior is the smaller. To the back of the globe the optic nerve is attached, rather to the inner side of the axis of the ball, and around it the nutritive vessels and the nerves are disposed. On a vertical section the antero-posterior diameter of the ball will be found to exceed the transverse by about a line.

Position of optic nerve. Diameter.

The organ of vision is composed of certain parts essential to the function, and of others requisite for protection and support. Its sentient constituent is a fine expansion of the optic nerve (retina). To defend so delicate a stratum, certain denser structures or coats are arranged around it; and to absorb the superabundant rays of light entering the eyeball, one of them is covered by a layer of pigment cells. Within the nervous expansion are central transparent parts to bring the rays of light to a focus thereon, and in front of these is a moveable curtain (iris) to regulate the quantity of light admitted into the interior. Outline of the elements of the organ of vision.

The coats of the eyeball form three strata, which are arranged one within another, and are named sclerotic, choroid, and retina. The transparent media in the interior are likewise three, viz. the lens, the aqueous humor, and the vitreous body. Number of coats and central parts.

The SCLEROTIC COAT (cornea opaca) is the most external stratum of the eye-ball, and forms a firm, whitish, and opaque covering, which supports the more delicate structures within. Sclerotic coat is fibrous.

Dissection. — To examine the inner and outer surfaces of this coat as well as the cornea, it will be necessary to cut circularly through the sclerotic with a blunt pointed scissors, close to the cornea; then to separate the cornea from the front of the eye-ball, by detaching a structure (ciliary muscle) that fixes it slightly; and lastly to remove the other structures from the interior of the sclerotic covering. In raising the cornea, the student may observe the aqueous fluid escape from its chamber. The central parts of the ball are to be set aside for subsequent use. Dissection to see the interior.

This tunic of the eye is bell-shaped, and extends from the entrance of the optic nerve to the margin of the cornea, forming about three fourths of the ball. At its posterior part and a little to the inner side of the centre (one eighth of an inch), the optic nerve is transmitted through an aperture in it: this opening decreases in size from without inwards, and is rendered cribriform by the union with its margin of the bundles of fibrous tissue between the funiculi of the nerve. Other smaller apertures for the passage of the nutritive vessels and nerves are situate around that for the optic nerve. In front is the large rounded hole into which Form and extent. Apertures behind and in front.

the cornea is received: it measures about half an inch transversely, and rather less from above down. On the outer surface this coat is smooth, except where the muscles are attached; but on the inner aspect it is covered with a flocculent cellular layer, and with the ends of ruptured vessels and nerves, and is of a dark colour. The sclerotic covering is thickest at the back of the eyeball, but it becomes thinner and whiter towards the cornea, where it is visible as the "white of the eye."

Outer and inner surface.

Thickness.

Structure. — The sclerotic coat is formed of layers of white fibrous tissue mixed with yellow or elastic fibres, which cross mostly at right angles, and construct this dense membrane for the maintenance of the globular form of the eyeball. A few irregularly shaped pigment cells are scattered amongst the fibres towards the cornea.

Formed of white and yellow tissue

with pigment cells.

Cornea. — This thin transparent membrane (cornea pellucida) fits into the front of the eyeball, of which it forms about one fifth. Its shape is circular, though, when viewed in front, it appears largest in the transverse direction in consequence of the sclerotic structure reaching further on it above and below than on the sides. It is smooth and soft to the touch, is convex anteriorly but concave posteriorly, and is of equal thickness throughout. At the circumference it is blended with the sclerotic coat by continuity of tissue. This clear and diaphanous structure, resembling in appearance the glass of a watch, bounds the anterior chamber of the eyeball, and gives passage to the rays of light entering the organ. In the healthy condition blood-vessels do not permeate its structure, but cease in loops at its circumference. When the cornea is supported by the aqueous humour, it deflects the rays of light transmitted to the eye, and thus influences by its greater or smaller convexity the different degrees of sight at a distance. After death it becomes flaccid from the transudation of the aqueous humour; or if it is immersed in water it is rendered opaque by infiltration of the tissue by that fluid.

Cornea:

extent and form.

Curve.

Situation in front of the sclerotic.

Has not blood-vessels.

Its action on the rays of light.

Structure. — The cornea is laminar in texture, and is constructed of a special, thick basement part called *cornea*

Composed of layers.

proper. In front of this is a thin elastic layer with an epithelial stratum, and behind is another fine elastic membrane covered by an epithelium: the two structures in front of it constitute the conjunctiva.

The *cornea proper* (lamellated cornea) is made up of a series of layers, about sixty in number, which are united by intervening pieces of tissue, and cannot therefore be detached one from another.* This structure possesses great toughness; and its transparency depends upon the parallelism of the different strata, and their distance from one another being maintained, for, if they are disarranged by compression or other means, the translucency is destroyed. Between the layers there are elongated tubular spaces, which are mostly parallel on the same level, but cross obliquely those on a plane beneath, from which they are usually distinct; these intervals do not contain fluid, but are moistened by a vapour. The laminæ of the cornea are formed of white fibrous tissue, continuous with that of the sclerotic coat, but here flattened into membranous layers which are arranged one over another.

Cornea proper is formed of layer.

with intervals between.

Its tissue continued into that of the sclerotic.

The *posterior elastic layer* may be peeled off after a cut has been made across the cornea. It is a thin, but dense and hard membrane, that tears readily when an attempt is made to detach it, and curls up when it is separated; it is always transparent, and remains so after boiling, after the action of acids, and even after maceration. At the edge of the cornea this lamina ceases in processes which turn backwards, and become blended with the ciliary ligament, and with the outer margin of the iris. Though very elastic, this membrane is apparently without a definite structure. A laminar *epithelium*, like that on serous membranes, clothes its free surface.

Posterior elastic layer:

characters;

attachment at margin;

has an epithelium.

The *anterior elastic layer* is also a transparent structure, similar in its properties to the posterior, which extends over the front of the cornea, and seems to be the basement mem-

Anterior elastic layer is part of conjunctiva;

* The facts given here, and in many other places in the description, are obtained from the work of Dr. Todd and Mr. Bowman, "Physiological Anatomy," part the third, 1847.

brane of the conjunctiva. From its posterior surface fine processes are continued into the cornea proper; and on its anterior aspect is the conjunctival *epithelium*, which is formed of three or four layers of scales, the deeper of these being columnar, but the superficial laminar in form.

has an epithelium.

Choroid coat is vascular.

CHOROID COAT. — The next coat or covering of the ball of the eye is within the sclerotic, and is formed chiefly of blood-vessels and pigment cells; its strength is but slight, and its interior is lined by a pigmentary membrane.

Dissection to see the choroid coat.

Dissection. — Supposing the sclerotic coat of an eye cut through near the anterior part, as before directed (p. 707.), it will be necessary to bring into view the choroid, to take away in water the rest of the sclerotic by means of an incision directed backwards on each side of the ball to the optic nerve. In removing the flaps of the outer coat, some cellular connections are to be broken through, but the slender vessels and nerves are to be preserved. The white ring around the eye in front is the ciliary ligament, which limits the extent forwards of the black choroid coat.

To see the ciliary processes by an anterior and a posterior view.

For the purpose of seeing the anterior termination of the choroid coat in the ciliary processes, take another eyeball on which the sclerotic covering has been divided, and the cornea removed as before; after making two or three cuts in the sclerotic towards the optic nerve, pin out the resulting flaps to the wax in the plate, so as to support the eye in an upright position. Let another eye be prepared in the same manner. On the one ball, in which the anterior view of the processes is to be obtained, proceed to remove with care the iris, tearing it away both from the white ring of the ciliary ligament, and from the ciliary processes beneath, so as to leave these undisturbed and displayed. On the other ball a posterior view of the processes is to be prepared: in this dissection the iris is to be left in its natural position, but the choroid coat is to be divided all round with a scissors, a little behind the ring of the ciliary ligament, and to be taken away with that ligament, the attached iris, and the ciliary processes behind — all in one piece. By gently washing the back of the iris the small processes will be made manifest. By means of the last dissection, the interior of the choroid coat may be seen. The structure of the membrane may be examined on a fragment obtained from the eye destroyed in making the preparation of the sclerotic coat.

To see the interior and the structure.

To make a vertical section.

If a vertical section is made of another eyeball, it will show the ciliary processes in their natural position, and will demonstrate the

relative situation of all the parts. This section, which it is difficult to make, should be attempted in water with a sharp, large knife, and on a surface of wax or wood: after the eye has been divided, the halves should remain in water.

The choroid coat is a thin membrane of a dark colour, and forms a segment of a sphere: like the sclerotic it extends from the optic nerve to the fore part of the eyeball. When viewed on the eye in which the ciliary ligament is entire, it appears to end at the ligament; but it may be seen in the other dissections to be reflected inwards behind that ring and the iris, and to end in a series of pointed processes (ciliary) around an anterior opening for the admission of the rays of light. This covering is thicker and stronger behind than in front. Posteriorly it is pierced by a round aperture for the passage of the optic nerve, and anteriorly is the large opening within the ring of the ciliary processes. The outer surface is flocculent, and is covered by the remnants of a pigmentary areolar tissue (membrana fusca) between it and the sclerotic coat; on it may be seen small veins arranged in parallel arches as they open into the larger trunks, and lying on this surface are the ciliary vessels and nerves. The inner surface is smooth, and is lined by a thin pigmentary epithelial layer (membrana pigmenti), though in the eye of the ox it shines through that layer with a metallic lustre.

Form and extent.

Anterior termination.

Openings.

Outer surface rough;

inner smooth.

The *ciliary processes* are the folds or plaits by which the choroidal coat is terminated in front, and are arranged around the lens, like the many petals of a flower, forming a circle (corpus ciliare). These processes lie side by side, and consist of larger and smaller folds; the former are from sixty to seventy in number, whilst the latter do not reach the free extremity of the other kind, and often blend with the larger ones. The large folds are thin and broad externally at the commencement, near the ciliary ligament, but increase in thickness internally, and projecting inwards half the depth of the iris, end in free points around the lens. At the posterior aspect the ciliary processes are closely connected with the membrane of the vitreous humour, for they fit into hollows between other folds on the front of that membrane. In front they are in contact with the back of the

Ciliary processes.

Position.

Two kinds: small,

and large.

Connections with parts around.

iris, with the tissue of which they are continuous towards their outer part, but are unattached to that structure towards their inner part, and assist to bound posteriorly the chamber of the aqueous humour.

Parts entering into its structure. *Structure.*—The choroid coat and the ciliary processes are formed principally of blood-vessels, with dark pigment cells, for there is only a small quantity of white fibrous tissue intermixed with the other structures.

A plexus of blood-vessels In the substance of this membrane the vessels may be seen in an injected eye to form a net-work of capillaries, whose interstices are rather less towards the back than the front of the eyeball. with large meshes externally, On the outer surface the larger branches of both arteries and veins lie side by side, and the veins form parallel curves (*vasa vorticosa*) as they end in four or five chief efferent trunks; but very close internally. but on the inner surface the capillary plexus has smaller meshes than elsewhere, and this part of the choroidal coat is sometimes described as a separate layer (*tunica Ruyschiana*). In the interspaces of the vessels towards the outer surface there are ramified irregular pigment Pigment cells only externally. cells, which contain a nucleus and molecular grains of dark brown colouring matter; but towards the inner surface, where the vessels form a very close plexus, the pigment cells are wanting.

Structure of ciliary processes. In the ciliary processes there is also a texture of ramified blood-vessels, with intermixed pigment cells, as in the choroid coat, but the cells are in greatest abundance on the under or posterior aspect.

Pigmentary layer The *pigmentary membrane* (choroidal epithelium).—On the inner surface of the choroid coat is a pigmentary thin formed of cells that contain the pigment. lining. This structure is easily detached, and may be seen with the microscope to consist of a single stratum of five or six-sided nucleated cells with granular contents. Though the layer covers the interior of the choroid coat the quantity of contained pigment varies at different spots; Occasionally pigment absent. for in the eye of the ox the colouring matter is absent from the cells in the bottom of the eye, and allows some fibrous tissue of the choroid (*tapetum*) to shine through it; and in the albino the pigment is altogether deficient in the cells, so that the vessels give a red appearance to the interior of the eye. This dark

layer absorbs the superabundant rays of light entering the eyeball.

Ciliary Ligament and Muscle.—In the eye from which the sclerotic coat has been removed, the white band of the ciliary ligament (*annulus albidus*) may be seen in its natural position in front of the part of the choroid coat that is reflected inwards to form the ciliary processes. This circle is situate in the ball of the eye nearly opposite the junction of the cornea with the sclerotic tunic, and seems to serve the purpose of suspending the iris and uniting the other coats at the fore part of the eye. Externally it is closely connected with the sclerotic; internally the iris is attached to it; and behind it is a greyish stratum (ciliary muscle) on the surface of the choroid coat for about one eighth of an inch. It consists of fibrous tissue, and is pierced by both the ciliary vessels and nerves.

Ciliary ligament. Situation. Connections with other parts.

The *ciliary muscle* consists of unstriped fibres, and forms a greyish layer on the surface of the choroid coat, close to the ciliary ligament. It is connected externally with the sclerotic, and the fibres are directed backwards and inwards, some to end on the choroid coat, and others to dip behind the ciliary ligament to blend with the ciliary processes. The nerves to the iris pierce its fibres.

Ciliary muscle. Attachments.

The iris is a vascular contractile structure, whose vessels are continuous with those of the choroidal tissue. Its position and connections may be observed in the different dissections that have been prepared.

Iris is vascular and muscular.

It is suspended vertically in the space between the cornea and the lens, in front of the aperture in the anterior part of the choroid coat, which it partly closes, and is pierced by an aperture for the transmission of the rays of light. It is circular in form, is variously coloured in different individuals, and is immersed in the aqueous humour.

Situation; form;

By its circumference the iris is connected with the ciliary ligament, and thus with the sclerotic close to the cornea. The aperture in it is named the *pupil* of the eye; this is slightly internal to the centre, and is nearly circular in form,

attachment. Situation and size of

the central aperture.

but its size is constantly varying (from $\frac{1}{20}$ to $\frac{1}{5}$ of an inch) by the contraction and relaxation of the muscular fibres, according to the degree of light acting on the optic nerve.

Anterior surface; posterior.

The anterior surface is free in the aqueous humour, and is marked by lines converging towards the pupil; the posterior surface is blended at the circumference with the ciliary processes, but is free in the inner half, and is covered with a thick layer of pigment, to which the name *uvea* has been applied.

Elementary structures.

Structure.—The iris is composed of some unstriped muscular fibres, of a plexus of blood-vessels, and of pigment cells between the vascular twigs.

Muscular fibres both radiating and circular;

Muscular fibres.—On examining the iris with a lens after it has been washed, its fibres will be found interlacing and converging towards the pupil, where they are connected with a more or less perfect ring of fibres around that aperture. During dilatation of the pupil the radiating fibres are thrown into a wavy state, but during its contraction they are stretched.

use.

The involuntary movements of the iris regulate the quantity of light admitted into the eye.

Pigment cells determine the colour.

The *pigment cells* in the iris are irregular in shape, like those in the choroid coat, and are scattered in the same manner through the tissue. The colour of the anterior surface of this part appears to be dependant upon a difference in their number and arrangement.

Arteries are radiating

and looped as the fibres.

The *arteries* of the iris have a looped arrangement, something like the muscular fibres. They are derived chiefly from the long and the anterior ciliary branches, and on arriving at the ciliary ligament form a circle around the margin of the iris; from this loop other anastomotic branches are directed towards the pupil, where they terminate in a second arterial circle. Some vessels enter the iris from the ciliary processes.

Membrane of the pupil in the fetus; situation;[1]

Membrane of the pupil.—In the fetus before the eighth month, the aperture of the pupil is closed by a vascular transparent membrane, which is attached to the iris over the situation of the inner vascular circle, and divides the space in which the iris is suspended, into two distinct chambers. Vessels shoot into it from the circle before referred to, and

communicate across the centre; but at about the eighth month the vessels become impervious, and at the time of birth only fragments of the membrane remain. *time of disappearance.*

Ciliary Vessels and Nerves. — The arteries that supply the choroid coat, the ciliary processes, and the iris, are named ciliary, and are offsets of the ophthalmic artery (p. 44.): they are classed into posterior and anterior, and two of the first set are named long ciliary, but they will not be seen without a special injection of the vessels of the eye. *Arteries of the eyeball are*

The *posterior* (short) *ciliary* branches pierce the sclerotic coat around and close to the optic nerve, and run on the surface of the choroid membrane till they enter its substance. Two of this set (long ciliary) are directed forward to the ciliary ligament, one on each side of the eyeball, the outer one lying rather above, and the inner one rather below the level of the axis, and form a circle around the iris, as before explained, before being distributed in the texture of that part. *posterior at the back; two of them named long ciliary.*

The *anterior ciliary* arteries are smaller than the posterior, and arise at the front of the orbit, chiefly from muscular branches: they pierce the sclerotic coat about a line behind the cornea, and join the arterial circle of the long ciliary vessels before they end in the iris. In inflammation of the iris these vessels are enlarged, and form a ring around the cornea. *Anterior ciliary at the front.*

The *veins* leaving the choroid coat are commonly four in number, and the branches entering these trunks form arches (*vasa vorticosa*) on the surface: they perforate the sclerotic layer at separate points, midway between the cornea and the optic nerve, and end in the ophthalmic vein. *Veins form vasa vorticosa, end in the ophthalmic.*

The *ciliary nerves* are derived from the lenticular ganglion, and from the nasal nerve (p. 43.). Entering the back of the eyeball with the arteries, they are continued forwards with the vessels between the sclerotic and choroid coats as far as the annulus albidus: at this spot the nerves pierce the fibres of the ciliary muscle and ligament, and end in branches to the iris; they are said to supply the ciliary muscle. — (Todd and Bowman.) *Ciliary nerves end in iris and ciliary muscle.*

Chamber of the aqueous humour. — The space between the cornea in front and the lens behind, in which the iris is suspended, contains a clear fluid named the aqueous humour. In the fetus this interval is separated into two distinct parts by the iris and the pupillary membrane, but in the adult it is *Space contains aqueous humour*

is partly divided into two by the iris.

unequally and only partly divided, for the two communicate through the pupil. There are two chambers described in the adult, whose boundaries may be seen in the eye in which a vertical section has been made.

Anterior part,

The anterior part of the space, anterior chamber, is the larger of the two, and is limited in front by the cornea, but behind by the ciliary ligament and the iris. The posterior space or chamber is less than half the size of the anterior; it is bounded in front by the iris; behind by the lens, covered towards the circumference by a piece of the membrane of the vitreous humour, and still further out by the ciliary processes, as these are inclined obliquely from the back of the iris to the lens.

posterior; its boundaries.

Aqueous humour.

The aqueous humour is quite transparent, and consists nearly of pure water. A small quantity of chloride of sodium, with some extractive matter, is in solution in it. It has been supposed that this fluid was secreted by a special membrane lining the cavity, but evidence of such a structure is wanting.

Retina is formed by optic nerve.

RETINA.—This coat (tunica nervea) is formed by an expansion of the optic nerve, and is the most delicate of all the structures in the eyeball. On it the rays of light are brought to a focus so as to produce an image of the object observed.

Dissections to see the retina.

Dissection. — The retina can be satisfactorily examined only on an eye that is used before forty-eight hours have expired after death. To bring it into view, take the eyeball on which the choroid coat was dissected, and tear away carefully that covering with two pair of forceps when it is immersed in water. If an entire eye is used for the purpose, pass a thread through the cornea, and fasten it to a pin fixed in wax; then remove in water the sclerotic and choroid coats, and the retina will be laid bare. The interior of the retina may be seen in the eye from which the cornea, iris, and corpus ciliare have been removed.

Situation in eyeball;

The retina is the most internal of the three concentric strata in the globe of the eye, and is situate between the choroid coat and the transparent mass (vitreous humour) that is lodged in the interior. It is moulded upon the vitreous body that gives it support; and its form is that of a segment

form

of a sphere, like the other coats, but its aperture in front is rather large. Beginning behind in the optic nerve, this thin layer extends forwards nearly as far as the annulus albidus, or to the spot at which the choroid coat becomes folded (outer margin of the corpus ciliare), where it ends in a wavy border, named *ora serrata*.

and extent;

This nervous expansion is of a greyish colour, and is semi-transparent when fresh, so that an image can be seen at the bottom of the eye through it when the two external coats are removed; but it soon loses this translucency, and is moreover rendered opaque by the action of water and other substances. Its thickness is greater at the posterior than at the anterior part of the eyeball.

colour; transparency and thickness.

On the outer surface are some fine shreds, fragments of a structure to be noticed presently (Jacob's membrane), which float in the fluid in which the preparation may be placed, and in a fresh eye dissected from behind a continuous layer of this membrane may be detached with care. On looking to the inner surface through the vitreous body, it will be found covered with accidental folds, in consequence of the absence of due support, and at the spot where the optic nerve expands (*porus opticus*) is the central artery of the retina. But in the interior of the human eye, in the axis of the ball, and $\frac{1}{8}$ of an inch outside the entrance of the optic nerve, is a slight roundish eminence of the retina, of a yellow colour, and $\frac{1}{24}$ of an inch in diameter, which is named the yellow spot of Sœmmerring (*limbus luteus*). In the centre of that spot is placed a minute aperture, *foramen centrale* of Sœmmerring, which is supposed to penetrate through the nervous layer of the retina, though not through the outer flocculent stratum or the membrane of Jacob. In the eye of a fetus of the ninth month, which had been hardened in chromic acid, Mr. Bowman found the foramen to be but the narrow neck of a small "follicular pouch" of the retina, which projected towards the vitreous body.*

Outer surface is flocculent.

On the inner surface are seen porus opticus, limbus luteus, foramen centrale.

Structure.—In the retina are two layers or strata of dif-

Two

* Vol. vi. p. 102. of the Dublin Quarterly Journal of Medical Science.

layers in the retina. ferent materials, together with blood-vessels; the inner of the two is formed by nervous substance, and the outer by Jacob's membrane.

One of nerve substance The *layer of nerve substance* is made up of the same elements as the grey matter of the encephalon, viz. of a granular matrix containing different-sized nerve cells, with nerve fibres: these constituents have the following arrangement:— has two strata, The nerve fibres having become solid in texture and grey in colour from the absence of the white substance of Schwann, an inner of altered nerve tubules, radiate from the end of the optic nerve, and communicate together to construct a thin stratum at the inner aspect of the nervous layer; this delicate lamina diminishes in strength as it is followed forwards, and it cannot be traced backwards quite to the foramen of Sœmmerring, but its place over that spot is taken by a layer of nucleated cells (Todd and Bowman). and an outer of granular and nuclear bodies. Outside these nerve fibres is another stratum of the granular material, which contains large scattered nucleated vesicles towards its inner aspect, and a number of nucleus-like cells towards its outer surface: it begins around the entrance of the optic nerve, and becomes thinner, like the fibrous, as it extends forwards.

Blood-vessels in this layer. In the nervous layer is a *plexus of blood-vessels* which is derived from the central vessels of the retina in the optic nerve (p. 44.). When the nerve becomes membraniform the artery divides into four or five branches, that pierce the stratum of fibres, and end in a network in the granular matrix outside them, like the blood-vessels in the grey substance of the encephalon, and without forming a separate layer (Todd and Bowman). The larger branches of the artery keep clear of the axis of the eyeball, and of the spot of Sœmmerring. In the fetus a branch of the artery is distributed to the back of the lens.

Outer layer is formed by Jacob's membrane; its structure. The *membrane of Jacob*, which forms the outer layer of the retina, is found, under the microscope, to be composed of club-shaped bodies arranged vertically, so as to construct a thin membranous covering. One end of these bodies is pointed, and is turned to the nervous layer of the retina, whilst the opposite larger end is directed outwards to the pigmentary lining of the choroid coat. In water they are

soon detached from one another, and the larger ends, which seem to be produced by the bending of the stem, become partly uncurled and resemble a hook.

Vitreous body.

VITREOUS BODY. — A transparent mass fills the greater part of the space within the coats of the eyeball, which has been named vitreous body from its resemblance to glass; it consists of a clear aqueous fluid, contained in a translucent membrane, and has the consistence of jelly.

To obtain a view of it.

Dissection. — The vitreous body will be seen by taking away the retina, the ciliary ligament and processes, and the iris, from the eye on which the retina was dissected. To obtain a view of its anterior part with the lens in situation, an eyeball should be pinned upright on wax, after the sclerotic and choroid coats are cut through about two lines behind the cornea (p. 710.); by removing carefully the cornea, and the ciliary ligament and processes, the vitreous body will become apparent.

Part of the globe filled by it.

Outer surface.

In front are the lens and corona.

The vitreous body is globular in form, and fills three fourths of the ball of the eye, reaching forwards nearly to the iris. By its outer surface it is in contact with the retina which it supports, but between the two is a layer of transparent nucleated cells (Todd and Bowman). In front the vitreous body is slightly hollowed, and receives the lens with its capsule, to which it is closely united; and around the lens are some streaks of pigment, in the position of the ciliary processes, which resemble the corolla of a flower.

Structure; a web of tissue containing water.

The fluid of the vitreous body has nearly the same composition as the aqueous humour (p. 716.), and is contained in the meshes of a close web of fibrous tissue. Enveloping the whole is a thin membrane named *hyaloid.*

Hyaloid membrane

sends inwards septa.

Arrangement of these.

The *hyaloid membrane* is the fine transparent covering of the vitreous body, which does not appear to have blood-vessels and nerves. It passes continuously over the surface of that mass; moreover, it sends inwards processes that are directed towards the centre, but do not appear to meet in the middle line, and thereby divide the tissue into segments, as in an orange. In the fetus there is a canal in the centre of the vitreous mass, named the *hyaloid canal*, through which a branch of the vessel in the optic nerve is conveyed

to the back of the capsule of the lens.* (Hanover.) In front the membrane is attached to the capsule of the lens on the anterior aspect, and near the margin; but it is not continued beneath that case, for the septa in the interior of the vitreous mass are fixed to the back of the capsule. Around the lens, where the surface is striated, the hyaloid membrane is marked by a series of folds or plaits, constituting the *zonula ciliaris*, by which it is connected with the choroidal ciliary processes.

In front is attached to capsule of the lens

and ciliary processes.

Corona ciliaris

The *corona ciliaris*, or the zonule of Zinn, is the striated and plaited part of the hyaloid membrane, which is placed around the lens, and intervenes between this and the anterior termination of the retina. When the pigment is washed away the plaits or folds of the zonule, *ciliary processes*, are found to resemble the processes of the choroid coat, but they are less prominent and longer. These two sets of folds are dovetailed together, the prominences of one membrane being received into hollows on the other; and they are further united by a layer of nucleated cells. — (Todd and Bowman.)

is marked by folds

that are fitted between ciliary processes.

Canal of Petit;

Canal of Petit. — Around the margin of the lens is a small canal, about two lines across, which has received the above name. It is placed beneath the plaited part of the hyaloid membrane, and is excavated in the substance of the vitreous body. When the canal has been opened and distended with air, it is sacculated at regular intervals, like the large intestine, in consequence of the inflation of the plaits of the hyaloid membrane.

situation;

anterior part sacculated.

Lens of the eyeball.

CRYSTALLINE LENS AND ITS CAPSULE. — The crystalline lens is a solid, transparent, doubly convex body, which is situate behind the pupil of the eye, and acts chiefly in bringing to a focus on the retina the rays of light passing through that aperture.

Open capsule of lens.

Dissection. — The lens will be obtained by cutting across the thin membranous capsule in which it is enclosed.

* Mr. Bowman's recent researches (Dublin Quarterly Journal) seem to corroborate the statements of Hanover respecting the structure of the vitreous body.

The lens is contained in a capsule, and is seated in a hollow on the front of the vitreous body. The anterior part projects towards the iris and the pupil; whilst the posterior is received in the vitreous body, and is attached thereto by fibrous processes that are fixed to the capsule. The circumference is below the level of the surface of the vitreous mass, and corresponds to the canal of Petit. Situation and connections.

The curve of the lens is unequal on the two surfaces, the posterior being greater than the anterior, and the margin is somewhat rounded. The density increases from the circumference to the centre; for whilst the superficial part rubs off easily with the finger, the deeper portion is hard and firm, and is named the *nucleus*. Its measurement from side to side is from one third to half an inch, and from before back about one eighth of an inch. On each surface are three lines diverging from the centre, and reaching to within a third of the margin; they are the edges of septa, and are so situate that those on one side are intermediate in position to those on the other. In the human eye they are not distinctly seen, because they bifurcate repeatedly as they extend outwards. Surfaces are curved unequally; density; dimensions; lines on the surfaces.

Covering the surface of the lens, and connecting it with the capsule, is a layer of very transparent nucleated cells, which can be recognised only in a fresh eye (Todd and Bowman). After a little time these cells absorb water, probably from the aqueous humour, and break down to form the fluid called *aqua Morgagni*, but naturally there is not any fluid between the lens and its capsule. A layer of cells joins it to the capsule.

Structure. — After the lens is hardened by spirit or boiling, it may be demonstrated to consist of a series of layers arranged one within another, like those on an onion, and each layer to be formed of minute fibres. No blood-vessels are found in its texture. It consists mostly of albumen. Lens is laminar.

The *laminæ* of each surface have their apices in the centre, where the septa meet, and may be detached from one another at that spot, and turned outwards. Each is constructed of minute fibres, that are continued from surface to surface over the margin of the lens. The constituent fibres Form of the laminæ

constructed of minute fibres that are wavy at the edge, and attached to the septa by their ends.

of the laminæ are about $\frac{1}{5000}$ of an inch in diameter, but they are flattened at the margin of the lens, and the deeper fibres are narrowed and less separate. In the superficial laminæ they have slightly wavy edges, by which contiguous ones are dovetailed together: this digitation is best seen in the lens of the codfish. They are connected at their extremities to the partitions on the opposite surfaces of the lens in this way: those that are attached to the root of a septum on the one aspect are fixed to the extremity of a septum on the other surface, and the rest of the fibres passing between two septa begin and end at opposite points in each.

Changes in situation; form, colour, and consistence.

Changes with age. — In infancy the lens is situate further forwards than in adult age, and touches the iris. Its form is nearly spherical in the fetus, but its convexity decreases with age, particularly on the anterior aspect, until the lens becomes flattened in old people. In the fetus it is reddish in colour, is soft, and is not quite transparent; in youth and mature age it is firm and clear, and in old age it becomes denser and of a yellowish colour.

Capsule of the lens; its anterior part is firm and transparent; posterior thin and fibrous;

The *capsule* of the *lens* is a firm transparent case that closely surrounds the lens. Its anterior surface is free in the posterior chamber of the eye, but gives attachment towards the circumference to the hyaloid membrane; its posterior surface is connected with the vitreous body by fibrous processes. The anterior part of the capsule is three or four times thicker than the posterior, and supports itself after the removal of the lens; it is firm and quite transparent, and remains clear after immersion in spirit or maceration in water, like the elastic layer of the cornea. The posterior part of the capsule, which is thin and membranous, is rendered opaque by spirit.

vessels to it.

In the adult human eye the capsule of the lens is not supplied with blood-vessels; but in the fetus a branch of the central artery of the retina passes through the vitreous body to supply it on the posterior aspect.

CHAPTER XI.

DISSECTION OF THE EAR.

THE ear is the organ through which sounds are perceived. It is made up of many complex parts that are lodged in or are attached to the surface of the temporal bone. Definition.

The sentient structure in this organ is formed, as in the eyeball, by an expansion of a special nerve over a membrane containing fluid. This structure is enclosed in the dense osseous substance, and is surrounded by certain accessory bodies that collect, and convey to it the undulations to be perceived, or influence the effect of the same on the auditory nerve. Outline of the elements of the organ of hearing.

The several parts constituting the auditory apparatus may be arranged into two sets, viz. those outside, and those within the substance of the temporal bone. Arrangement into two sets.

A. The external set (outer ear) which are to be first examined include the pinna or auricle, and the auditory canal: the former has been noticed at page 33., and the latter is described below. Outer set.

The AUDITORY CANAL (*meatus auditorius externus*) is the passage which leads from the pinna to a cavity in the temporal bone named the tympanum, and transmits sounds inwards. Auditory canal.

Dissection.— To obtain a view of this canal, a recent temporal bone is to be taken, on which the cartilaginous pinna remains attached. After the soft parts are removed, the squamous part of the bone in front of the Glasserian fissure is to be sawn off, and the fore part of the meatus is to be cut away with a bone forceps, except the portion below that gives support to the thin membrana tympani. How to obtain a view of it;

This canal is about one inch and a quarter in length, and is formed partly by bone, and partly by cartilage and mem- length;

direction; brane. It is directed forwards somewhat obliquely, and is bent downwards about the middle of the osseous part, so that the floor slopes from that spot both outwards and inwards.

size and shape. In shape it is rather flattened from before backwards; and it is narrowest at the bent part. The outer extremity is continuous with the hollow (concha) of the external ear, and the inner is closed by the membrana tympani.

Cartilaginous part *a.* The *cartilaginous* part is about half an inch in length, and is formed by that portion of the pinna of the outer ear which is attached to the margin of the meatus; but at the

is deficient above. upper and posterior aspect the cartilage is deficient, and the tube is closed by fibrous tissue. Two or three fissures (of Santorini) are found in the piece of cartilage.

Osseous part is bent; *b.* The *osseous* part is about three quarters of an inch long in the adult, and is constricted about the middle, where it is

outer end; bent as before said. Its outer extremity is dilated, and the posterior projects more than the anterior part; the margin here is rough, and gives attachment to the cartilage of the

inner end; pinna. The inner end is less dilated, and is marked by a groove in the dry bone, except above, for the insertion of the membrane of the tympanum; it is sloped very obliquely, so that the anterior wall exceeds the posterior by about two lines.

condition in the fetus. In the fetus the osseous part is absent, but after birth it grows out of the osseous ring (tympanic bone) that supports the membrana tympani, and becomes joined to the rest of the temporal bone.

Lining membrane is derived from the skin. *Lining of the meatus.*— A prolongation of the integument lines the auditory passage, and is continued over the membrane of the tympanum in the form of a thin pellicle. Around the entrance of the meatus are some fine hairs. In the subcutaneous tissue of the cartilaginous part of the

Ceruminous glands. meatus are some ceruminous glands, which secrete the ear wax, and open on the surface; but these are most abundant in that portion of the tube which is formed by fibrous tissue.

Vessels. *Vessels and nerves.*— The meatus receives its *arteries* from the posterior auricular, the internal maxillary, and the

Nerves. temporal branches of the external carotid trunk. Its *nerves* are derived from the auriculo-temporal branch of the fifth

nerve, and enter the auditory passage between the bone and the cartilage (p. 87.).

B. The internal constituents of the auditory apparatus, that are enclosed within the temporal bone, consist of two large spaces, named tympanum and labyrinth, with their accessory parts. Internal set of auditory parts.

The TYMPANUM, or drum of the ear, is a hollow interposed between the meatus auditorius and the labyrinthic cavity, which is lined by mucous membrane, and filled with air. It communicates with the pharynx by a tube (Eustachian), and is traversed by a chain of small bones that has muscles and ligaments connected with it. The vessels and nerves of the space are numerous and minute. Tympanum.

Dissection.—The tympanic cavity is to be opened both in a dried and in a recent bone. On the dry temporal bone, remove most of the squamous portion by means of a vertical cut of the saw directed through the root of the zygoma, and along the Glasserian fissure. By cutting away with the bone forceps the anterior part of the meatus auditorius, and the projecting bone above that forms the roof of the cavity, the tympanum will be brought into view. Dissection to open it in the dry bone,

In the recent bone, in addition to the preparation already made of the meatus auditorius, the roof of the tympanum should be taken away only as far as may be necessary, and without doing injury to the membrana tympani, the chorda tympani nerve, and the chain of bones with its muscles. and in the recent bone.

The cavity of the tympanum has the form of a small, round, and flattened box, placed on the side, for the outer and inner boundaries are flat, and the circumference is circular. Its size is greater from point to point of the circumference than across the space, or from without inwards, being in the former direction about half an inch, but in the latter not more than half that measurement. Form and dimensions.

The inner boundary is of greater extent than the outer, and on it the following objects are to be noticed. About the centre is the large projection of the *promontory*, which becomes pointed posteriorly, and is marked by two or three minute grooves that lodge the nerves forming the anastomosis of Jacobson. At the posterior or narrowed part of the promontory are two large apertures, one above and the other Inner wall is marked by promontory and its grooves.

below it, which lead into the labyrinthic space. The upper opening resembles in shape the half segment of a circle, with the convexity placed upwards, and is named *fenestra ovalis*: towards the vestibule (part of the labyrinth) it has a sharp, prominent margin, and into it, in the recent state, the inner bone (stapes) of the osseous chain is fixed. The lower aperture is in form like the upper one, though more arched, and the base is vertical and directed backwards: it is named *fenestra rotunda*. In the recent state it is closed by a thin membrane, *secondary membrane* of the tympanum; and, in the dried bone, an osseous ridge may be seen within its margin, which divides it into two parts:—one leads into the vestibule, the other into the cochlea.

Fenestra ovalis, fenestra rotunda.

Its outer boundary membrana tympani and Glasserian fissure.

The outer boundary of the cavity is formed by the membrana tympani, and by a small part of the surrounding bone. Above the membrane and at its fore part, is the *Glasserian* or glenoid fissure, which is occupied, in the fresh condition of the body, by the long process of one of the small bones (malleus) in the tympanic cavity, and by a small muscle (laxator tympani). Crossing the membrane towards the upper part is the chorda tympani nerve.

Circumference; roof; floor; at back; opening of mastoid cells; pyramid; aqueduct of Fallopius.

The circumference of the tympanum is circular, but it is rough and uneven on the surface. In passing around the cavity, the student will detect in succession the objects that are noted below. The roof is flattened, and consists of the thin osseous plate forming part of the cranial surface of the temporal bone; but the floor is curved over the subjacent jugular fossa, and presents in the dry bone more or less of an areolar or spongy texture, as well as some small apertures that open into that fossa. At the posterior part of the circumference, towards the roof, is a large aperture leading into the mastoid cells. Below this aperture, but nearer the inner wall, and on a level with the narrowed part of the promontory, is a small conical projection, named the *pyramid*, which is perforated by an aperture, and contains the stapedius muscle: attaching it to the above-mentioned part of the promontory, is a small round spiculum of bone. Immediately above the pyramid, and arching over the fenestra ovalis, is a ridge of bone marking the situation of the aque-

duct of Fallopius. The front of the tympanic cavity corresponds to the carotid canal, only a thin scale of bone intervening. In it are the apertures of two canals that lie on the outer side of the passage for the carotid artery; the upper one contains the tensor tympani muscle, and the lower one is the Eustachian tube. Between the two canals is a thin osseous lamina, which is hollowed above and dilated at the inner end, and is named *processus cochleariformis*.

In front canals for tensor tympani and Eustachian tube, with bone between.

Two parts that have been referred to above, viz. the membrana tympani and the Eustachian tube, require a separate notice.

The *membrana tympani* is a thin partition between the meatus auditorius and the cavity of the tympanum. It is oval in form, taking the shape of the meatus, and is attached by its circumference to a grooved surface at the inner end of the auditory passage; but in the fetus it is fitted into a separate osseous ring, the tympanic bone. The membrane is placed very obliquely with respect to the meatus, so that it meets the floor of that space at an angle of 45 degrees, and the outer surface is directed downwards. Towards the auditory canal the surface is concave; but in the tympanum it is convex, and has attached to its upper half the handle of one of the tympanic bones (malleus).

Membrana tympani; state in the adult and the fetus. Situation; surfaces.

Structure.—This membrane is formed of three strata or structures, an external, internal, and middle. Two of these are obtained from common tissues of the body: thus, the outer one is cuticular, and is part of the integument lining the meatus; and the inner layer is derived from the ciliated epithelial covering of the mucous membrane of the tympanum. The middle stratum is formed of fibrous tissue, and is fixed to the groove in the bone as before said: from its centre, where it is connected with the handle of the malleus, fibres radiate towards the circumference, and near the margin at the inner aspect is a band of circular fibres.

It is formed of a cuticular, epithelial, and fibrous stratum.

The *Eustachian tube* is the channel through which the tympanic cavity is filled with air. It is about an inch and a half in length, and is directed downwards and inwards to the pharynx; like the meatus auditorius, it is partly osseous and partly cartilaginous in texture.

Eustachian tube has

an osseous part; The *osseous* part is rather more than half an inch in length, and is narrowed at the middle. Its opening in the tympanum situation and its situation with respect to the canal for the tensor tympani muscle have been alluded to; its course in the temporal bone is along the angle of union of the squamous and petrous portions, external to the aperture that contains the and termination. carotid artery. Externally it ends in a dilated and somewhat oval opening, with the longest measurement in a vertical direction, whose margin is irregular, and gives attachment to the special cartilage that completes the canal. The *cartilaginous* Cartilaginous part. part of the tube is nearly an inch in length, and extends from the temporal bone to the interior of the pharynx. Use of the tube. (See p. 121.) Through this tube the mucous membrane of the tympanum is continuous with that of the pharynx, and through it, by reason of its inclination downwards, the mucus passes from that cavity.

Ossicles of the tympanum are three. OSSICLES OF THE TYMPANUM.—Three small bones are united to form a chain across the tympanic cavity. The outer one is named malleus from its resemblance to a mallet; the next, incus, from its similitude to an anvil; and the last, stapes, because it is very like a stirrup. For the examination of these little bones the student should be provided with some separate dry specimens, as well as with those seen in position in the cavity.

Malleus has The *malleus* is the longest bone and is twisted and bent: it is large at one end (head) and small and pointed at the other (handle), and has besides two processes, with a narhead, rowed part or the neck. The *head* (capitulum) is free in the cavity, is oval in shape, and is smooth except at the back, where there is a depression for articulation with the neck, next bone. The *neck* is the slightly twisted part between handle, the head and the processes; the *handle* (manubrium) decreases in size towards the tip, and is flattened from before backwards, except at the extremity where it is compressed in the opposite direction: to its outer margin the membrana tympani is connected. The *processes* of the bone are two in short and long process. number, long and short:—the *short* one springs from the root of the handle on the outer side, and reaches the mem-

brane of the tympanum; the *long* process (processus gracilis) is a slender point of bone, but seldom altogether ossified, which is connected with the neck of the malleus on the anterior aspect, and extends into the Glasserian fissure.

The *incus* is a flattened bone, and consists of a body and two processes. The *body* is hollowed at the upper and anterior part to articulate with the malleus. The two *processes* (long and short) extend from the side opposite to the articulation: — the shorter process is somewhat conical, and is received into the aperture of the mastoid cells; the long process decreases towards the extremity, where it curves and ends in a rounded and convex point, the *orbicular* process.

Incus. Its body, processes: short and long, with orbicular point.

The *stapes* has, like a stirrup, a base or wider part, and two sides or crura that are blended at the opposite end in a head. The base is formed by a thin osseous plate, which is convex at one margin and almost flat at the other, corresponding to the shape of the fenestra ovalis; the surface that is turned to the vestibule is convex, whilst the opposite is excavated. The *head* is marked by a superficial depression, that receives the orbicular process of the incus; and below it is a constricted part, the neck of the bone. The *crura* extend from the base to the neck, and are grooved, like the base, on the inner surface: the anterior crus is shorter and straighter than the other.

Stapes; base: head: crura.

Position of the ossicles.—The *malleus* is placed vertically in the tympanum, with the head upwards, and its articular surface turned backwards to be connected with the incus: its handle is attached externally to the membrana tympani, and its long process is directed forwards to the Glasserian fissure. The *incus* is so placed that the long process is vertical, and the short one horizontal. Externally it is united with the malleus, and its processes are thus disposed: — the short one is received posteriorly into the mastoid cells; and the long process descends, like the handle of the malleus, but rather posterior to it and nearer the inner wall of the cavity, to join inferiorly with the stapes. The *stirrup* bone has a horizontal position, with the crura directed forwards and backwards: its base is fixed into the fenestra

Position of the malleus, of the incus, and of the stapes.

ovalis, and its head is united with the long process of the incus.

The bones have two sets of ligaments; *Ligaments of the ossicles.* — The small bones of the tympanic cavity are united into one chain by articular ligaments, and are further kept in position by ligaments that fix them to the surrounding bone.

either to join one to another *a. From one bone to another.* — The ossicles are connected together at the points where they touch by articulations corresponding to those of larger bones, for the osseous surfaces are covered with cartilage, and are surrounded by a capsular ligament of fibrous tissue, whilst a synovial sac lubricates the whole. By means of these joints, perfect freedom of movement of the bones is secured to convey inwards the vibrations of the membrana tympani to the labyrinth. by two perfect joints, One articulation of the nature above described exists between the heads of the malleus and incus, and a second between the extremity of the long process of the incus and the head of the stapes. In the recent bone a thin membrane closes the interval between the crura of the stapes, and is attached to the groove on their inner aspect.

or to fix them to the tympanic wall. *b. Between the bones and the wall.* — The bones are kept in situation by the reflection of the mucous membrane, and by special ligaments. From the head of the *malleus* a short suspensory band of fibres is directed upwards to the roof of the tympanum. Another ligamentous band passes backwards from the *incus*, near the end of its short process, to the posterior part of the containing cavity; and the base of the *stapes* is connected to the margin of the fenestra ovalis by fibres that constitute an orbicular ligament.

Three muscles to the ossicles. *Muscles of the ossicles.* — Two muscles are plainly seen in connection with the chain of bones, which possess striped fibres. One of these is attached to the malleus, the other to the stapes. A second muscle for the malleus is sometimes described.

Tensor tympani is in a bony canal, which gives it origin. The *tensor tympani* (internal muscle of the malleus) is contained in a special bony canal, and to see it completely this must be laid open: it is the largest and most distinct of the muscles of the tympanum, and takes the shape of the containing tube. The muscle *arises* from the surface of its bony canal, also slightly in front from the cartilage of the Eustachian tube, and its fibres are directed backwards; posteriorly it ends in a tendon, which is reflected over the

end of the cochleariform process as over a pulley, and is *inserted* into the anterior part of the handle of the malleus, near its base. The action of this muscle is expressed by the name. It receives a special nerve from the otic ganglion. And is inserted into malleus. Action.

The *stapedius* is lodged in the canal hollowed in the interior of the pyramid. Arising from the circumference of the tube, the muscle ends in a small tendon that issues from the pyramid, and is *inserted* into the neck of the stapes at the posterior part. It assists in keeping the stapes applied to the fenestra ovalis. Stapedius is in the pyramid attached to stapes. Action.

Laxator tympani (external muscle of the malleus).—The muscular nature of this band is doubtful. It is connected externally with the spinous process of the sphenoid bone, and passing through the Glasserian fissure is attached to the neck of the malleus above the processus gracilis, or to that process. Laxator tympani is doubtful.

Mucous membrane of the tympanum.—The mucous lining of the tympanic cavity adheres closely to the wall, and is continuous with that of the pharynx through the Eustachian tube: it assists to close the fenestra rotunda, and is, moreover, continued into the mastoid cells through the aperture leading into these. Its surface is covered with a ciliated *epithelium*. A layer of epithelium can be detached from the inner surface of the membrana tympani, in the same manner as a cuticular stratum may be separated on the outer side. Lining of tympanum closes fenestra rotunda. Epithelium.

BLOOD-VESSELS.—The *arteries* of the tympanum are furnished from the following branches of the external carotid, viz., internal maxillary, posterior auricular, ascending pharyngeal, and some offsets come also from the internal carotid, whilst it is contained in the temporal bone. The *veins* join the middle meningeal and pharyngeal trunks. Arteries are branches of carotid.

a. The internal maxillary artery supplies first a *tympanic branch* (inferior), that is distributed as described below; next it gives an offset to the cavity from the petrosal branch of the middle meningeal artery, which enters the temporal bone by the hiatus Fallopii. From internal maxillary.

b. Some twigs to the back of the cavity, and to the mastoid cells, are derived from the *stylo-mastoid* branch of the posterior auricular artery, which enters the lower end of the aqueduct of Fallopius. Posterior auricular.

One of this set, *superior tympanic*, anastomoses with the tympanic branch of the internal maxillary artery, and forms a circle around the membrana tympani, from which branches are directed inwards.

Inferior palatine. *c*. Other branches from the *ascending pharyngeal*, or from the *inferior palatine* artery, enter the space along the Eustachian tube.

Nerves from several sources. NERVES. — The lining membrane of the tympanum is supplied by the tympanic plexus — a communication established between Jacobson's and the sympathetic nerve; but the muscles derive their nerves from another source. Crossing the cavity is the chorda tympani branch of the facial nerve.

Dissection to prepare the nerves *Dissection.*—The preparation of the tympanic plexus will require a separate fresh temporal bone, that has been softened in hydro-chloric acid, after the nerves have been hardened in spirit. The origin of Jacobson's nerve from the glosso-pharyngeal is first before entering, to be sought close to the skull (p. 101.); and the auricular branch of the pneumo-gastric to be looked for at the same time.

and in the tympanic cavity. Supposing the nerves to be found, the student should place the scalpel on the outer side of the Eustachian tube, and carry it backwards along a line passing through the vaginal and styloid processes of the temporal bone, so as to take away the outer part of the tympanum, but not to open the lower end of the aqueduct of Fallopius, lest the facial nerve should be injured. Now the tympanum is laid open, Jacobson's nerve is to be followed in its canal, and the branches that lie in the grooves on the surface of the promontory are to be pursued — one of these arching forwards and two coursing upwards.

The connections of the chorda tympani nerve can be seen on the preparation used for the muscles.

Tympanic nerve The *tympanic branch* of the glosso-pharyngeal nerve (nerve of Jacobson, p. 103.) enters a special aperture in the temporal bone, and is conducted by it to the inner wall of supplies membrane the tympanum. At this spot the nerve supplies filaments to the lining membrane of the cavity, and furnishes the and other branches; three following branches, that are contained in grooves on the promontory, and connect this nerve with others.*

* Instead of viewing these filaments as offsets of the nerve of Jacobson, it may be supposed that they are branches derived from the nerves they are connected with, which unite in the tympanum to form the *tympanic plexus.*

One branch is arched forwards and downwards, and enters the carotid canal to communicate with the sympathetic on the artery (p. 110.). A second is directed upwards to join the large superficial petrosal nerve in the hiatus Fallopii (p. 134.). And the third filament has the following course to reach the otic ganglion: it first ascends towards the upper surface of the petrous part of the temporal bone, passing in front of the fenestra ovalis, but beneath the canal for the tensor tympani muscle, and near the gangliform enlargement on the facial nerve, to which it is connected by filaments (p. 136.). Beyond the union with the facial, this nerve is named *small superficial petrosal*, and is continued forwards external to the hiatus Fallopii, but without appearing on the surface of the temporal bone, until it issues from the osseous substance to end in the otic ganglion (p. 138.).

One to the sympathetic, another to petrosal nerve, and a third to otic ganglion, called small petrosal.

Nerves to muscles.—The tensor tympani muscle is supplied by a branch from the otic ganglion (p. 138.); and the stapedius receives an offset from the facial nerve (Sœmmerring).

Nerves for the muscles.

The *chorda tympani* is a branch of the facial nerve, which is now seen in the part of its course through the tympanum. Entering the cavity behind, it crosses the membrana tympani, and issues from the space by a special aperture to join the gustatory nerve. It is described at page 137.

Chorda tympani crosses cavity.

The *auricular branch* of the vagus nerve, though not a nerve of the tympanum, is an offset to the outer ear, and may be now traced in the softened bone. Arising in the jugular fossa (p. 105.), the nerve enters a canal which conducts it across the lower end of the aqueduct of Fallopius, and through the substance of the temporal bone to the back of the pinna of the ear. In the bone it joins the facial nerve.

Branch of vagus to the outer ear.

THE LABYRINTH.—The inner and fundamental portion of the organ of hearing is so named from its complexness. It is formed partly of dense osseous bodies, and partly of membranous sacs containing fluid on which the auditory nerve is distributed. It is divided into an osseous and a membranous labyrinth.

Labyrinth formed of osseous and membranous parts.

A. The osseous labyrinth consists of three parts, viz. the vestibule, the semicircular canals, and the cochlea; these communicate externally with the tympanum, and internally with the meatus internus that transmits the auditory nerve.

Constituents of the osseous part.

The VESTIBULE is the common central cavity of the osseous

Vestibule. labyrinth, and is placed behind the cochlea but in front of the semicircular canals.

Dissection to see it. *Dissection.* — This cavity may be seen on the dry bone used for the preparation of the tympanum by means of the following cuts. Saw vertically through the temporal bone close to the inner wall of the tympanum, so as to expose this wall and the fenestra ovalis leading into the vestibule. In this section one of the semicircular canals (horizontal) will be laid open just above the fenestra ovalis. By enlarging the fenestra ovalis a very little in a direction upwards and forwards, the end of the superior semicircular canal and the vestibular space will appear. Other views of the cavity may be obtained by sections of the bone in different directions, according to the skill and the knowledge of the dissector.

Form, dimensions. The vestibular space is somewhat oval in form, the extremities of the oval being placed forwards and backwards, and the floor is more narrowed than the roof. It measures about $\frac{1}{5}$ of an inch in different directions, except from without inwards, in which direction it is narrower. The following objects are to be noted on the boundaries of the space.

Apertures before and behind. In front, close to the outer wall, is a large aperture leading into the cochlea; and behind are five round openings of the three semicircular canals.

Crest on inner wall; fossa in front of it; and an aqueduct behind. On the inner wall, nearer the front than the back of the cavity, is a vertical ridge (crista). In front of the ridge is a small circular depression, *fovea hemispherica*, which presents anteriorly some minute apertures for nerves, and corresponds to the bottom of the meatus auditorius internus. Behind the crest of bone, near the common opening of two of the semicircular canals, is the opening of the aqueduct of the vestibule, which ends on the posterior aspect of the petrous portion of the temporal bone.

Outer wall has two apertures. The outer wall corresponds to the tympanic cavity, and in it are the apertures of the fenestra rotunda and fenestra ovalis.

Roof has a fossa. On the roof is a slight transversely oval depression, *fovea semi-elliptica*, which is separated from the fovea hemispherica by a continuation of the crista before mentioned.

Three canals; The SEMICIRCULAR CANALS are three osseous tubes, which are situate behind the vestibule, and are named from their form.

Dissection. — These small canals will be rendered visible after the removal of the surrounding bone by means of a file or some cutting instrument. Two may be seen opening near the aperture made in the vestibule, and may be followed thence, but the third is altogether towards the posterior aspect of the petrous portion of the temporal bone. preparation of them;

The canals are of unequal lengths, but each forms more than half a circle; they communicate at each end with the vestibule, and the contiguous ends of two are blended together so as to give but five openings into the cavity. Each is marked by one dilated extremity which is called the *ampulla*. When a tube is cut across, it is not circular but is compressed laterally, and measures about $\frac{1}{20}$ of an inch, though in the ampulla the size is as large again. length; termination by five openings; one end dilated; form and size.

From a difference in the direction taken by the tubes, they have been named superior and posterior vertical, and horizontal. The *superior* vertical canal crosses the upper border of the petrous part of the temporal bone, where it forms a projection. Its extremities are more distant than in the other tubes; its outer end is marked by the ampulla, whilst the inner is joined with the following. The *posterior* vertical tube is directed backwards from its junction with the preceding towards the posterior surface of the temporal bone; the upper end is united with the superior vertical canal to form a common tube, and the lower end is free and dilated. The *horizontal* canal has separate apertures, and is the shortest of the three. Deeper in position than the superior vertical, it lies in the substance of the bone nearly on a level with the fenestra ovalis; its dilated end is at the outer side close above that aperture. They are named superior vertical, posterior vertical, and horizontal.

Cochlea. — This part of the osseous labyrinth has a position anterior to the vestibule, and has received its name from its resemblance to a snail's shell. Cochlea.

Dissection. — To obtain a view of the cochlea in the dried bone, it will be needful only to cut or file away gradually the surface of bone forming the promontory of the tympanum, on the preparation before used for displaying the vestibule, or on another piece of bone in which the semicircular canals are not laid bare. The horizontal direction of this body will be best seen by cutting away the Dissection for it in dry

and recent bone. bone above it. To dissect the same parts in the recent state, a softened bone should be used.

Form and situation; The cochlea is conical in form, and is placed almost horizontally in front of the vestibular space. The base of this body is turned to the meatus auditorius internus, and is perforated by small apertures, whilst the apex is directed to the upper and anterior part of the inner wall of the tympanum, opposite the canal for the tensor tympani muscle. size. Its length is about a quarter of an inch, and its width at the base is about the same. Resembles a snail-shell in some respects. Resembling a snail-shell in construction, the cochlea consists of a tube wound spirally round a central part or axis; but it differs from a shell in the fact of the tube being subdivided into two by a partition, and in the circumstance of the central part or axis being much thicker.

Parts of the cochlea. In describing the several parts of the cochlea it will be necessary to notice separately its axis or centre, its spiral tube, with the two passages into which it is subdivided, and the partition between them.

A spiral tube closed at one end forms $2\frac{1}{2}$ turns; The *spiral tube* forms two turns and a half around the axis, and terminates above in a closed extremity, named the *cupola*. Of the turns the first is much the largest, and includes the rest within its coil: at its commencement it projects into the tympanum, and gives rise to the eminence of the promontory on the inner wall of that cavity. When measurement; measured along the outer side, the tube is about one inch and a half long; its diameter at the beginning is about one-tenth of an inch, but it gradually diminishes to half that size towards the opposite end. In the recent bone the tube is is divided into two. divided into two passages (scalæ) by a septum. A remnant of this partition is seen in the dry bone in the form of a thin plate of bone (lamina spiralis): and, on the outer wall, opposite this ridge of bone, is a slight groove.

A central pillar or axis The *axis* or *modiolus* consists of the bony substance included within the coils of the spiral tube; it is formed externally by a condensed stratum — the wall of the spiral is porous and conical; tube; and, internally, by a porous material. Its form is conical, and its size diminishes rapidly towards the last half

turn of the spiral tube, where it is very thin, and presents a free margin; but at the apex it widens a little, becoming funnel-shaped, and forms the *infundibulum.* The axis is perforated by canals that transmit vessels and nerves in the fresh state; and the central one is larger than the others. how it ends above in the infundibulum.

Winding around the axis is a thin osseous plate, the *lamina spiralis*, which projects half-way across the spiral tube, and forms part of the septum. It begins inferiorly within the vestibule, and, diminishing in size in its progress, ends in a point, named the *hamulus*, opposite the free margin of the modiolus in the last half turn of the cochlea. Between the point in which the osseous lamina terminates and the margin referred to is an aperture (*helicotrema*), that allows of the communication of the passages of the spiral tube in the recent condition. The lamina spiralis is formed on the exterior of two plates of bone that are separated furthest at the modiolus, and enclose osseous canals for vessels and nerves. Around it is a spiral piece of bone, that ends above in a point over an aperture, through which the scalæ join.

Septum of the spiral tube. — The partition dividing the tube of the cochlea into two passages in the recent bone consists of an osseous and a membranous portion. Septum of the tube bony and membranous.

a. The *osseous* part, which is formed by the lamina spiralis, extends rather more than half way across the tube, and is covered by the lining membrane of the cochlea. The side turned to the lower of the two cochlear passages is freely pierced by nerves and vessels; whilst the opposite is covered, according to Todd and Bowman*, in the outer fifth of its extent, by a structure resembling cartilage, which ends in a toothed edge near the margin of the spiral lamina, and is named by them *denticulate lamina.* Osseous part; difference on two sides: on upper aspect is the denticulate structure.

b. The *membranous* part reaches from the edge of the lamina spiralis to the groove opposite in the outer wall of the tube of the cochlea, and is continued upwards to the top of that tube beyond the extent of the bony part of the partition. Near the lamina spiralis this structure has a glassy appearance, like the elastic layer of the cornea; but beyond that spot it is a gelatinous-looking tissue to which the authors above quoted have given the name *cochlearis muscle*, be- Membranous part; extent upwards; piece glassy,

* In the work before referred to, "Physiological Anatomy," &c.

piece soft, the cochlear muscle. cause it was found by them to be constructed of pale or unstriped fibres, like those of the ciliary muscle of the eyeball.

Two scalæ of the cochlear tube *Scalæ of the cochlea.*—These are the two passages into which the spiral tube of the cochlea is divided by its septum. They are named *scala vestibuli* and *scala tympani*, and the former is nearest the apex of the cochlea. Above they communicate through the aperture named helicotrema; and below they open into the vestibule, one (scala tympani) being very near the fenestra rotunda, and the other in the front of the cavity. On the whole they are nearly equal in size, but each has certain peculiarities: thus the vestibular scala alone extends to the apex of the cochlea; whilst the tympanic scala is largest near the base, and connected with it at the beginning is the small *aqueduct* of the cochlea, that opens on the under aspect of the petrous portion of the temporal bone, near the jugular fossa.

that join above, and end in vestibule;

differ in extent and size at spots.

Fibro-serous membrane lines the labyrinth; *Lining membrane of the osseous labyrinth.*—A thin membrane of a fibro-serous character lines the vestibule, the semicircular canals, and the scalæ of the cochlea, and is likewise continued into the aqueducts of the vestibule and cochlea.* On the outer wall of the vestibule it closes the openings into the tympanic cavity. The outer surface of the membrane is adherent to the bone; but the inner is covered by an epithelium, and secretes a thin serous fluid, *liquor Cotunnii*, or perilymph. This fluid in the interior fills the scalæ of the cochlea, and surrounds the membranous labyrinth.

has an epithelium and contains a fluid that fills cochlea.

Two sacs float in fluid of labyrinth. B. The MEMBRANOUS LABYRINTH is constituted of sacs containing fluid, over which the special nerve of the sense of hearing (auditory) is expanded. The sacs are two in number, viz. the utricle and the saccule, and have the general form of the surrounding bony parts: they are confined to the vestibule and the semicircular canals, and are surrounded by the perilymph.

* This membrane was supposed by Breschet to be originally part of the fibro-serous lining of the skull, which has been enclosed by bone, until the connection between the two has been obliterated, except through the small process that lines the aqueduct of the vestibule. — *Recherches Anatomiques et Physiologiques.*

Dissection.—The delicate internal parts of the ear, with their vessels and nerves, cannot be dissected except on a temporal bone, that has been put in spirit, and afterwards softened in acid. The previous instructions for the dissection of the osseous labyrinth will guide the student to the situation of the membranous structures within it, but the surrounding softened material must be removed with great care. A lens and a microscope will be needed for the complete examination of the sacs. For the display of the blood-vessels a minute injection should be made of them. Dissection of them in a fresh bone.

The *utricle*, or the common sinus, is the larger of the two sacs, and is situate at the posterior and upper part of the vestibule, corresponding to the fovea semi-elliptica in the roof. It is transversely oval in form, and connected with it posteriorly are three looped tubes that are prolonged into the semicircular canals. The sac and its prolongations are filled with a clear fluid, like water, which is named endolymph; and in its wall is a small calcareous deposit (otolith) opposite the entrance of the nerve into it. The utricle: situation and form; contains a fluid and otolith.

The prolongations into the semicircular canals are smaller than the osseous tubes, being only one third of their diameter, and are surrounded by the perilymph. In form they resemble the bony case, for they are marked at one end by a dilatation corresponding to the ampulla of the osseous tube, and, further, two are blended at one end, like the canals they occupy. They communicate with the utricle by five openings, and are filled with the endolymphic fluid of that sac. At each ampullary enlargement there is in the interior a transverse projection into the cavity, and here a branch of the auditory nerve enters the wall. Tubes are sent into the arched canals, dilated at one end, contain a fluid.

The *saccule* is a smaller and a rounder cyst than the utricle, and is placed in front of it in the hollow of the fovea hemispherica. Like the larger sac, it has a translucent wall, in which is an otolith opposite the entrance of the nerve; it is also filled by endolymph. It is doubtful whether the two sacs communicate. Smaller sac is before the other. Do the two join?

Structure of the sacs.—The wall of the membranous labyrinth is translucent and firm, but it is more opaque where the vessels and nerves enter it. Three strata of different materials enter into the construction of the membrane, Wall of the sac has three strata.

together with blood-vessels and nerves. The outer covering is loose and flocculent, and easily detached, and contains irregular pigment cells. The middle layer is clear and tough, and appears like cartilage, or, where it is thin, like the hyaloid membrane of the eyeball (Todd and Bowman); and the inner one is formed by a stratum of nucleated cells, that are easily separated from one another.

Otoliths are grains of lime in cells.

The small calcareous masses, or the otoliths, consist of minute grains of carbonate of lime deposited in cells (Krieger), and connected with the inner part of the wall of the utricle and saccule. Within the enlargement of the semicircular tubes the calcareous material (otolith) is contained in the cells lining it.—(Todd and Bowman.)

Blood-vessels of the membrane.

Blood-vessels. — The membranes of the labyrinthic cavity receive their blood from an artery that enters the internal auditory meatus with the nerve. The veins are united into one, and end in the superior petrosal sinus.

Internal auditory artery

The *internal auditory* artery arises from the basilar trunk within the skull (p. 166.), and enters the internal meatus with the auditory nerve. In the bottom of that hollow it divides into two branches — one for the vestibule, another for the cochlea.

has a branch to membranous sacs; termination;

a. The *branch* to the *vestibule*, after piercing the wall of the cavity, subdivides into small branches, that ramify on the exterior of the membranous labyrinth, and are continued on the tubes occupying the semicircular canals. The vessels end in a network of capillaries in the substance of the membranous wall, as well as on the interior about the termination of the nerves.

and another to the cochlea.

Mode of termination.

b. The *branch* to the *cochlea* subdivides into small twigs that enter the canals in the modiolus. Small offsets from these are directed outwards in the holes in the lamina spiralis, and communicate together in loops near the margin of that osseous zone, but in greatest number towards the tympanic scala. From this anastomosis vessels are supplied to the membrane lining the scalæ, and to the cochlearis muscle. A capillary vessel is placed longitudinally in the membranous part of the septum scalarum, and communicates here and there with the arterial arch before mentioned. — (Todd and Bowman.)

The *vein*. — One branch of vein is derived from the cochlea, and another from the membranous labyrinth : the two are united near the cochlea, and the trunk ends in the superior petrosal sinus.

Vein to petrosal sinus.

Nerve of the Labyrinth. — Only one special nerve, *auditory*, is distributed to the labyrinth. Entering the internal auditory meatus (p. 18.), the nerve divides into two branches, like the artery, viz., an anterior for the cochlea, and a posterior for the membranous labyrinth.

Auditory nerve divides into two.

a. The *cochlear branch* divides at the base of the modiolus into twigs that enter the apertures therein. These small divisions of the nerve are directed outwards with the vessels in the canals in the lamina spiralis, but nearest the tympanic scala, where they form a plexiform arrangement, with lengthened interspaces. Beyond the bone the nerve tubules cease to divide, and reach a short distance into the membranous part of the septum scalarum, where they are arranged in sets parallel to one another, and each set is rather conical in shape in consequence of some tubules ceasing sooner than the rest. The nerve fibres do not lose the white substance of Schwann at their termination, but retain it in the minutest tubules. — (Todd and Bowman.)

A cochlear branch, whose filaments end in the septum, retaining white substance.

b. The *vestibular branch* ends in three nerves for the membranous labyrinth : these pierce the cribriform plate in the bottom of the meatus, and are thus distributed : — one appertains to the utricle, and to the enlargements on the tubes contained in the superior vertical and horizontal semicircular canals ; a second ends in the saccule ; and the third belongs to the ampullary swelling on the tube of the posterior vertical semicircular canal.

Vestibular branch divides into three;

Termination of the vestibular nerves. — The ending of the nerve fibres on the sacs is different from their termination on the ampullary enlargements.

their termination;

In the *membranous sacs* the nerve enters where the otolith is situate, and its filaments separate, some passing amongst the calcareous matter, and spread out on the inner surface. Meeting with the lining of nucleated cells, the tubules lose the white substance of Schwann, and end in a "fibrous film," like that of the inner stratum of the nervous layer of the retina (Todd and Bowman). The same authors state that the tubules surrounded by the otolith

on the sacs lose white substance

and end in fibres inside. appear to terminate in free points, without losing their white substance, as in the frog.

In the arched tubes they form a projection, and end in loops therein. In the *ampullary enlargement* of the tubes of the semicircular canals the nerve enters the concave side, where it forms a forked eminence (Steifensand), corresponding to the projection in the interior. The nerve tubules do not spread out as in the sacs, but are confined to the swelling in which they end in a series of loops (Wagner). In the cod-fish the nerves are said to terminate in free extremities as well as in loops. — (Todd and Bowman.)

INDEX.

The letter (o) prefixed to the figures refers to the origin, (c) to the course, and (d) to the distribution of a nerve or vessel that is described in different pages.

THE END.

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